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Yakama Nation Wildlife Management Areas

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HABITAT EVALUATION PROCEDURES

Wildlife Management Areas
Yakama Nation, Washington

Project No. 1992-062-00
Contract No. 9018

June 20, 2000

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1.0 INTRODUCTION

1.1 BACKGROUND ON WILDLIFE MANAGEMENT AREAS

Construction of the Dalles, Bonneville, McNary, and John Day Dams on the Columbia River by the federal government resulted in a substantial loss of riparian bottomland along the Columbia River. Impacts associated with the Mid-Columbia Projects were assessed for several wildlife species using the Habitat Evaluation Procedures (HEP) developed by the U.S. Fish and Wildlife Service (USDI-FWS 1980). The studies documented the loss of riparian habitat and established a baseline against which mitigation measures could be developed (USDI-FWS 1990 and USDE-BPA 1990). The impact assessments established a mitigation goal, a portion of which would be satisfied by the creation, restoration, and enhancement of riparian lands on tributaries to the Columbia River, including the Yakima Valley.

The Yakama Nation (YN), the Northwest Power Planning Council, and the Bonneville Power Administration have agreed that the Yakama Nation would be funded to implement habitat restoration on lands within and adjacent to their reservation. Some of the targeted lands are owned by the Yakama Nation, some are trust lands, and some lands have been in private ownership.

Since the early 1990s, the Yakama Nation has been in the process of assembling riparian lands into Wildlife Management Areas, and restoring natural hydrology and natural cover-types on these lands. The Northwest Power Planning Council, through the Bonneville Power Administration, has supported the program.

The Yakama Nation's wildlife mitigation lands are located in the Yakima Valley, on various parcels on the south side of the Yakima River from the town of Wapato, downstream to the town of Mabton, and adjacent to portions of Toppenish Creek and Satus Creek south of the town of Toppenish (Figure 1). The Yakama Nation has identified specific parcels of riparian land adjacent to the Yakima River, Toppenish, and Satus Creek for management as Wildlife Management Areas (Figure 1). The acquisition and management of these lands is, in part, mitigation for wildlife and habitat impacts that have resulted from the construction and operation of the Mid-Columbia Dams.

1.2 SCOPE AND OBJECTIVES

HEP studies were performed by the Yakama Nation in 1990 (Bich et al. 1991) to establish baseline conditions and inventory wildlife habitat at the initiation of the restoration project. The 1990 HEP used a simplified version of the HEP to quantify baseline conditions.

The present assessment is designed to evaluate the progress of the mitigation plan in meeting its stated goals. The 1999 HEP assessment has two distinct tasks:

1. Evaluation of the mitigation plan as currently implemented using the simplified YN HEP methodologies for the Wildlife Management Areas.

2. Evaluation of the simplified YN HEP methodologies as a means of measuring mitigation progress.

1.3 Report Organization

This report has been organized to present a minimum of descriptive and analytic text, figures, and tables in the main body of the report. There is, however, a great deal of documentation, data, and analysis that supports the text. Figures and tables associated with the text and part of the main body of the report are identified by a simple table or figure number. Background and supporting material is found in the appendices. Appendix A is general material related to the sampling, Appendix B describes the Delphi Method sampling and analysis, and Appendix C describes the Yakama Method.

Appendix figures and tables are identified by the appendix prefix; for example, Table A-4 or C-7. Since the text may include references to main-body figures and tables, as well as appendix figures and tables, care must be used when reading the text.

1.4 Acknowledgments

We appreciate the assistance provided by Mr. Tracy Hames, Project Manager for the Yakama Nation and many other members of the Yakama Nation, and the field assistance provided by persons from various tribes, and federal, state, and local agencies. See Appendix Table A-1 for a list of participants and Table A-2 for the dates on which they participated. Paul Ashley, Washington Department of Fish and Wildlife (WDFW), supervised participants in the sampling and analysis of the data we gathered using the Department's procedures.

2.0 METHODS

To evaluate the success of the YN mitigation program to date, the simplified HEP used in the original analysis was repeated on the lands that have been incorporated into the plan. This allows comparisons with the baseline conditions and the current conditions using the same "currency" for the evaluation.

The simplified YN HEP approach was based on direct observations of habitat conditions and variables in the Habitat Suitability Index (HSI) models for each species, but not detailed field measurements of the variables in the HSI models.

The 1999 HEP evaluation used the inter-agency field assessment approach, with most HSI evaluations completed in the field as described in Bich et al. (1991). The same evaluation species and species models were used. However, the 1999 evaluations were conducted only on the lands that have been incorporated into the Yakama's Wildlife Management Areas. HEP scores were calculated for each mitigation unit, and the total for all units summed for comparison to the projected mitigation scores in the 1991 plan and the habitat mitigation objectives.

In addition we used the Delphi approach to estimate HSI values for each species by direct observation of overall habitat conditions, without estimation or measurement of individual parameters in the HSI models. A single score for each species for each sample area was estimated by a team member, and the scores for all team members were recorded and averaged to get a final HSI score for that plot. The results of this approach were then compared to the simplified YN method and the field measurements approach.

2.1 COVER-TYPE MAPPING

In 1990 (Bich et al. 1991) preliminary cover-type maps were used. Since that time, the Yakama Nation has acquired and now uses an ArcInfo (ENSR) geographic information system (GIS) for mapping and other spatial analysis. This report uses cover-type maps prepared by the Yakama Nation based upon cover-type analysis of recent aerial photographs. During the course of field studies in the summer of 1999, the preliminary GIS cover-type maps were ground-truthed and refined.

Table 1 provides the area of each cover-type in each of the Wildlife Management Areas based upon the revised GIS cover-type maps. The cover-types roughly follow those used by the Fish and Wildlife Service (USDI-FWS 1990 and USDE-BPA 1990) in their evaluations of impacts caused by development of the Mid-Columbia River Projects. However, the cover-types have been further expanded by the YN staff to distinguish cover-types that contain a significant coverage by exotic plant species.

Table 2 gives the simplified cover-type acreages used in the 1999 analysis by Wildlife Management Area. Table 3 provides a description of the cover-types, and the cover-type codes used in the YN computer GIS database and the corresponding U.S. Fish and Wildlife Service codes.

Restoration of a more natural hydrology and replanting of native grasslands has resulted in the replacement of pasture and croplands with natural grasslands and palustrine emergent wetlands since the 1990 HEP was conducted. Some of the shrub-lands that were heavily infested with Russian olive have been cleared of the shrub, which does not change its basic shrub cover-type, but does result in its changing from a shrub-land contaminated with exotics to a native shrub-land.

Substantial changes in other cover-type areas have not occurred because existing cover-types are slowly changing as active agricultural uses, including grazing, have been terminated or reduced, and as more natural conditions evolve. In these areas, changes are in the composition and quality of cover-types and not in their areas. As restoration of natural communities is a long-term process, the benefits of restoration are only beginning to appear.

2.2 Wildlife Species and Habitat Model Selection

In a HEP analysis (USDI-FWS 1980), the habitat (cover-types) is assessed for representative wildlife species. Species are selected to represent various guilds, foraging types, and use of various cover-types. For each species, for each cover-type that it uses, an assessment of habitat quality is determined. The descriptor of habitat quality is the Habitat Suitability Index (HSI). For each species for each used habitat, a HSI value is determined. The HSI value is multiplied by the habitat (cover-type) area to calculate the dimensionless Habitat Unit (HU).

In both the 1990 HEP study (Bich et al. 1991) and this HEP study, the species that are used follow those used in the baseline studies on the mainstem Columbia River (USDI-FWS 1990 and USDE-BPA 1990). In those studies, the investigators used a set of birds and mammals that reflected the use of various cover-types and represented a number of foraging guilds, and for which there were HEP models. Table 4 provides the species used in the analysis, the cover-types for which they were analyzed, and the manner in which they use the cover-type; for example, nesting, foraging, and/or hiding.

It should be noted that many of the species listed in Table 4 occur in many of the other habitats not analyzed in this HEP. As noted above, this analysis follows the protocols and species-habitat matrix of the 1990 HEP.

In the HEP procedures developed by the FWS, the relationship between a species and its habitat is described and semi-quantified by a word or mathematical model. These models seek to describe habitat conditions for a species using several habitat parameters or descriptors. Ideal habitat for a species has an HSI score of 1.0; habitat of no utility for a species would have an HSI score of 0.0, and intermediate habitats (or cover-types) would have intermediate HSI scores.

In their 1990 HEP analysis (Bich et al. 1991), the Yakama Nation used the same or similar HEP HSI models as had been used in the earlier Columbia River Studies (USDI-FWS 1990 and USDE-BPA 1990). In some cases the models were modified to better reflect local conditions in the Yakima Valley or were updated with refined models.

Table 5 lists the HEP models that were used in this study, the source of the model, its author, habitat parameters, appropriate habitats for measuring, and the computation procedures used to determine the Habitat Suitability Index (HSI). Table 5 also notes where models have been altered for use in this study based upon our field experience.

2.3 HEP METHODS

The 1990 Yakama HEP study method did not directly measure parameters or variables in the field to drive the HSI models. Instead, the Yakama 1990 method estimated the field parameters during visits to representative sample sites in each management area and each cover-type. The parameter values for each species model were estimated, species by species, at each sample plot. The estimated parameters were used to drive the standard models to calculate HSIs for each cover-type for each species (see Bich et al. 1991). Subsequently in this report, *Yakama Method* will refer to the field estimation of species/cover-type HSIs as described for the 1990 HEP project.

Some reviewers of the 1990 HEP study (Bich et al. 1991) criticized the Yakama Method for estimating the parameters rather than making detailed field measurements to calculate HSI values. For the 1999 HEP analysis, the Yakama Nation proposed to repeat sampling and calculation of HSIs and HUs in the same manner as the 1990 study, but also to sample some sites using field measuring methods. When setting up the 1999 field study, Raedeke Associates, Inc. suggested that it would be useful to also sample using the Delphi method. The Delphi method is an accepted HEP process in which the HSI values for each species are estimated in the field at each sample site. The HSIs are not calculated using a mathematical model, but rather a word model.

In addition, Raedeke Associates, Inc. suggested gathering additional environmental and land use information at each site so that a rich database could be developed, which could subsequently be used to analyze the effectiveness of the mitigation program and to evaluate the HEP methodologies.

2.3.1 Yakama Nation Method

Yakama Method Models and Data Forms

In 1990, the Yakama Nation staff estimated in the field each of the parameters used in each of the Bluebook HEP models, model by model (Bich et al. 1991). The parameters used in each species model were tabulated and sorted. A list of parameters was arranged that would sample each stratum - forest, shrub, herb - and the parameters that were unique to specific species models. Where possible, species models were modified to use the common set of parameters and to eliminate redundant measures. Table C-1 shows the parameters used to drive the models and Table C-2 shows the ordered list of sample parameters.

Data sheets were prepared for each of several major cover-type groups:

- Forest and Shrub
- Shrub-Steppe-Grassland, Grassland, Agriculture Crop, Agriculture Pasture, Herb
- Lacustrine, Open Water, Riverine, Emergent, Sand-Gravel-Cobble-Mud

Appendix C provides the data sheets as they finally evolved (Tables C-3, C-4, and C-5). The data sheets included the parameters that would be used for each species that would be present in the cover-types, as well as general stand information, start and end times, and the observers. The data sheet provided the step values and required that the observer simply check the step value.

Yakama Method Field Sampling

Field sampling was conducted during the middle two weeks of August 1999. Yakama sampling was performed following the Delphi sampling at each plot. Each morning and afternoon, the participants would travel to one of the Wildlife Management Areas. The pool of available people was divided into teams of three to five people and each team was assigned some cover-type locations to sample. At the sample plot, the team would inspect the cover-type, discuss the site and note the appropriate parameter step value. Each sample plot was given a unique day/location identifier and subsequently assigned a serial number. The plot identifiers and serial number were the same for both the Delphi plots and the Yakama Plots.

Yakama Method Data Entry and Analysis

Following ordering, review of entries, and annotation if necessary, the data were entered into an Excel spreadsheet. Entered data included location and other site information, the start time and the ending time, and the parameter step value as represented by the appropriate column number. The spreadsheet was reviewed for consistency and accuracy. Table C-6 is a copy of the master Yakama spreadsheet.

Table C-7 describes the step value for each parameter for each species. Table C-8 translates the step values into the appropriate variable value (V1, V2, V3, etc.) for each parameter for each species. Table C-6 was modified to include the variables for each species HSI model. Using the Microsoft Excel *Choose* Function, each column step value was replaced with the appropriate variable value. The portion of the table with the replaced variable values is Table C-9. Table C-10 provides the species HSI values derived for the variable scores for each species for each sample plot.

Habitat Units (HUs) for each species were calculated for each individual wildlife management area by multiplying the HSI scores for the cover-types sampled in that specific area by the habitat acreages in that wildlife management area as given in Table 1. In the case where a particular cover-type was not sampled in a given wildlife management area, the overall average for the entire study site was used.

2.3.2 Delphi Method

Delphi Word Models and Data Forms

For this method, verbal descriptions were prepared for each of the HEP species based upon HEP models, other references, and the substantial experience Yakama Nation biologists have acquired during many years of field work and management activities (Appendix B, Table B-1). The descriptions included not only descriptions of ideal habitat, but also descriptions of intermediate habitats. A field data form was prepared that asked for all of the information that was to be recorded in each plot (Table B-2). Participants in the field reviewed the word models for each species and entered the consensus habitat value on the data sheet.

Delphi Field Sampling

Field sampling was conducted during the middle two weeks of August 1999. Each morning and afternoon, the participants would travel to one of the Wildlife Management Areas. The pool of available people was divided into teams of three to five people and each team was assigned some cover-type locations to sample. At the sample plot, the team would review the species models and discuss conditions at the location and then assign an HSI score. The scores for each species were recorded on the data sheets of that sample plot. Each sample plot was given a unique day/location identifier and subsequently assigned a serial number.

Delphi Data Entry and Analysis

Following ordering, review of entries, and annotation if necessary, the data was entered into an Excel spreadsheet. Entered data included location and other site information, the start time and the ending time, and the species HSI scores. The spreadsheet was reviewed for consistency and accuracy. Table B-3 is a copy of the master Delphi spreadsheet. Table

B-3 was sorted by the cover-type row, and then the values for each cover-type for each species were summed and averaged.

For comparison with other HEP methods, the overall HSI score for all habitats for the individual species was calculated. Habitat Units were not calculated for comparison of the Delphi method as this would simply be multiplying the HSI score by a constant, and no new information is provided that would be useful in comparison of methodologies.

2.3.3 Transect Method

This method is based on field measurements of all parameters in the HSI models. For a description of the Transect Method see WDFW (1997), *Sunnyside Wildlife Area, Habitat Evaluation Procedures, Survey Workbook*, prepared by Ashley and Wahlen.

Paul Ashley, WDFW, supervised the participants in the using the transect sampling methods on a limited number of plots. Using the Transect Method, three riparian forest, two riparian shrub, and two shrub-steppe samples were taken. Mr. Ashley had to coach the participants through the more intensive sampling methodologies. The forest stands sampled were also infested with poison ivy so more care had to be taken while sampling.

2.4 Field Sample Design

The sample design for this study recorded information for the following factors or strata:

1. HEP Procedure type (Delphi, Yakama, or transect)
2. Wildlife Management Areas
3. Cover-Types
4. Wildlife Species

Prior to field sampling, proposed sampling methodologies, cover-type definitions, sample data sheets, and sampling protocols were developed. On July 24, 1999, Tracy Hames, Yakama Nation, and Richard Fleming, Raedeke Associates, Inc. visited several of the management areas and reviewed the cover-type mapping, evaluated the proposed models and sampling procedures, and estimated how much time it might take to collect samples.

On August 8, Paul Ashley, Washington Department of Fish and Wildlife, HEP Biologist, joined Fleming and Hames in eastern Washington. Again, cover-type maps were evaluated, sampling procedures were reviewed, and several Wildlife Management Areas were visited to gauge the range of conditions that would be sampled.

Field sampling was conducted over two weeks in August 1999. Yakama Nation biologists and other staff, Raedeke Associates, Inc. staff, and participants from various tribes, federal,

state, and county agencies assisted. Appendix Table A-1 identifies the participants and Table A-2 indicates the days on which sampling took place and who participated. In all, 19 persons participated in sampling on nine different days. There were approximately 51 person-days of field sampling.

Prior to sampling, estimates were made of the number of samples that would be required to adequately sample both Wildlife Management Areas and cover-types, given usual HEP practices. Estimates were also made of the amount of time that would be required to sample, and travel between the various sample areas scattered over more than 200 square miles, including rest and lunch in what was anticipated to be very warm conditions. Tables A-3, A-4, and A-5 in Appendix A show how these factors were calculated to determine how many person-days would be required. Tracy Hames used these estimates to determine the number of people he would request to assist with the field sampling.

Prior to field sampling, staff reviewed aerial photographs and cover-type maps for each Wildlife Management Area and target numbers of samples for each cover-type. They then marked candidate locations on the aerial photographs and cover-type maps for cover-type sample plots. Plots had to be reasonably accessible by foot from the access roads within the areas. Each day the number of samples in each cover-type and in each management area were entered on a tally sheet (summarized in Table 6) and candidates for sampling on the following day were determined given the anticipated size of the field crew.

To speed the process of field sampling, data sheets were developed that would permit participants with minimal experience to effectively gather data and to record all of the needed information.

3.0 RESULTS AND DISCUSSION

3.1 EVALUATION OF CURRENT HABITAT CONDITIONS

Current habitat conditions were evaluated for each Wildlife Management Area and for the total of all the areas. To calculate the HUs for individual Wildlife Management Areas, the HSI scores for each species for each cover type sampled were multiplied by the acreages in Table 2. When a particular cover-type present in a given area was not sampled in that area, the overall HSI score for all areas was used.

The current habitat units by Wildlife Management Area are given in Tables 7 to 13. The tables include the HSI scores used in the analysis. The bold HSI scores were from plots sampled in the specific area and the non-bold HSI scores are the overall average HSI scores. The overall total for all Wildlife Management Areas is given in Table 14.

The baseline 1990 habitat conditions in these same Wildlife Management Areas are summarized in Table 15. The table includes totals by species and by cover-type. The HUs were calculated by multiplying the HSI scores from the 1990 study (see Table 6 from Bich et al. 1991) by the reconstructed cover-type acreages in Table 16.

The overall habitat units in 1990 were 22,484 versus 24,568 in 1999. This represents an increase in habitat units of about 9 percent. This increase is due in part to habitat improvements in the intervening years. However, the total scores are also affected by changes in overall acreages within the areas, improved and revised cover-type mapping in 1999, and revisions in HSI models.

3.2 EVALUATION OF HEP METHODOLOGIES

The HEP process is based on the assumption that one can calculate habitat units (HUs) by multiplying an index of habitat quality (HSI values) for a given species by the amount of available habitat. As noted in the HEP documentation (See USFWS [1980] 102 ESM 4.2), "the fundamental step in determining HUs is to estimate or calculate HSIs for each evaluation species" and, "an HSI model can be in graphical, word, or mathematical format" (see USFWS [1980] 103 ESM 1).

The HEP guidelines go on to identify a number of ways to develop HSI scores, including word models (102 ESM 4.2B(2)), word rankings (103 ESM 2.1), indices based on species population measures (103 ESM 2.2), or models with undefined outputs (e.g., quantitative habitat models) (103 ESM 2.3). The HEP Workbook (see Chapter 5) notes that "there is no one correct way to build an HSI model."

In the present study, we calculated HUs based the following methods:

- **Yakama method:** a quantitative method where HSI model parameters are estimated in the field and used in the mathematical models to calculate the HSI score

- **Transect method:** also a quantitative method, but where the model parameters are based on field measurements to calculate HSI scores using the same mathematical models

- **Delphi method:** a method in which HSI values are derived from word models by a team of experienced biologists

Each of these methods has strengths and weaknesses. In this section, we compare the results of the different methods, using the average HSI score as the basis for the comparisons, and compare the amount of effort (measured in time) to conduct the different methods.

3.2.1 Comparisons of HSI Scores

The HSI scores based on the Delphi and Yakama methods are summarized in Tables 17 and 18. The tabled values are average HSI scores by species by cover-type for all plots. Table 19 provides a summary of overall HSI scores by species for the Delphi and Yakama methods.

At this time, we do not have HSI score results for the Transect method for comparison.

Even though we tried to make the data forms as explicit as possible, Delphi method sampling is more subjective than Yakama method sampling. Sampling teams were selected to include staff from the Yakama Nation. These staff persons have many years of experience in wildlife management on the lands we were assessing. Thus, we anticipated that Delphi method sampling might provide a more accurate estimate of habitat value to a species.

Average HSI scores for the Delphi method and the Yakama method show a variable pattern by species (Table 19). Overall, the Delphi scores are 28% lower than the Yakama method scores. The Delphi scores are substantially lower for the Canada goose, California quail, and mink, while the Delphi scores are higher for the great blue heron and western meadowlark. For the other species, the scores are similar, but sample size is quite small, with the exception of the mallard.

3.2.2 Comparisons of Effort Between Methods

To compare the amount of effort (measured in staff time needed to complete the analysis) we divided the methods into the three major analysis phases, including mobilization and field preparation, field data collection, and computation of scores.

Field Preparation Effort

The initial task for any HEP analysis would include the following steps:

- project scoping and study plan development
- species selection
- habitat cover-type mapping
- HSI model selection and/or development
- data collection preparations

The amount of effort to complete this phase of a HEP analysis would be identical for all three methods for the first three steps.

HSI model selection and/or development would differ between the Delphi method and the other two. The Yakama method and the Transect method both require mathematical models to calculate the HSI values for each species and cover type. Where models exist, minimal effort is required to obtain the models. However, time would be required to review the models, as the majority of the existing HSI models date to the early 1980s. If new models need to be developed, we estimate that a minimum of 2 person-days would be required to compile and review the literature, and prepare the model.

For the Delphi method, we estimate that it would require at maximum 2 hours to prepare a word model if an HSI model is in existence, and 4 hours if there is no HSI model.

Preparing field data sheets would again be similar for the Yakama and Transect methods, and would require several person-days. The Delphi method would require several hours to prepare simple data sheets to record the appropriate data.

In summary, the Yakama and Transect methods would require five to ten times more effort to prepare the HSI models and data sheets than would the Delphi method. However, for all methodologies, the habitat cover-type mapping and associated GIS analysis is the most labor intensive task and the amount of required effort is constant across methodologies.

Field Sampling Effort

Both the Delphi and Yakama sampling methods proceeded quickly in the field once the procedures became familiar. The Yakama Method was almost always faster than the Delphi Method as there was always a discussion within the sampling team to arrive at a

Delphi HSI value. The Delphi value is a balance of many factors and it was often necessary to review the word models and consider the various factors before a consensus score was decided upon.

In contrast, the Yakama Method required only the field estimation of the various parameter values. The field sheets provided step ranges for parameter values and the appropriate step was simply marked in the field. This usually did not require much discussion within a sampling team, and teams were more comfortable with estimating parameter step values than they were with estimating species HSI values.

The Transect Method sampling required much more time for team members to become familiar with the methodology and much more effort was required to calculate the parameter estimates. The Transect Method of sampling was usually conducted by teams of 6 to 10 persons. The size of the sampling team reflected the greater effort required by the sampling, but also the desire to introduce as many people as possible to the procedure. Teams of trained individuals could probably be reduced to 3 or 4 persons.

The average time to perform a Delphi method sample (n = 86 plots) was 8.1 minutes while the average time to perform a Yakama method sample (n = 88 plots) was 4.3 minutes. The average times for Transect method were: (a) riparian forest (n = 3 plots) 120 minutes, (b) shrub-steppe-grassland (n = 2 plots) 60 minutes, and (c) grassland (n = 1 plot) 45 minutes.

Computational Effort

There is no required effort to complete the computations on the Delphi methods, as the field results provide the final HSI values. The Yakama and Transect methods require virtually the same amount of effort to summarize and analyze the field date and compute the final HSI scores.

The calculation of the HSI scores for the Yakama and Transect methods is greatly simplified through the use of spreadsheets that incorporate the HSI quantitative models. As part of this analysis we constructed such spreadsheets, and future analysis for field data would require minimal effort (e.g., several person-days) for even a very large data set. We estimate the construction of the spreadsheets and model development for this project could have been completed in approximately 5 person-days, if the required quantitative models were provided as part of the first step in this process.

Table 20 provides a summary of the required effort to complete a HEP analysis using the three different methodologies. Included is a hypothetical example that has 100 sample points in the analysis, sampling for 10 species by a two-person field team. Where the amount of effort for the three methodologies is the same (e.g., cover-type mapping, GIS analysis), no value is included for simplification. It should be noted that the habitat mapping and GIS would be major components of the effort required for all methods.

Based on this analysis, the Delphi and Yakama methods are relatively similar in amount of effort required. The Transect method would require more than five times more effort to complete the same number of sample plots as compared to the other two methodologies.

3.2.3 Discussion of Methodologies

As noted above, USFWS has clearly stated in the HEP documentation that there is no absolute correct way to derive HSI scores, and as such, the results of one method are no more valid than those based on another method. In our evaluation we are most concerned with the amount of subjectivity, the amount of effort required, and the ability of the method to meaningfully capture the changes in habitat quality over time and/or in response to active habitat management.

Critics of the original 1990 Yakima HEP study suggest that detailed field measurements of HSI model parameters would provide more precise estimates of the habitat suitability than would estimates of the parameter values. Further, supporters of the Transect method for HSI calculation feel that the quantitative models used in the Transect method provide more precise measures of habitat suitability when compared to the word models used in the Delphi method.

The quantitative HSI models do give the impression of precision that may not be justified for several reasons. First, the HSI models are composed of a number of suitability indices, which are models of species response to different habitat factors. For example, the great blue heron HSI model includes models for the parameters: (V1) distance from feeding areas to nest areas; (V2) feeding area quality; (V3) human disturbance; (V4) nest area conditions; (V5) nest disturbance; (V6) distance between potential and active nest sites. In reality, each of the variable models was derived via the Delphi process, as there is no specific research results that provides these specific models (see Stabins and Raedeke 1992). They are the best professional judgment of the individual or team that constructed the model and are a very rough approximation of how they think the animals respond to multiple habitat features in a simultaneous manner.

Second, the final HSI score is derived by some combination of these variables in a simple algebraic formula. Again, in the case of the great blue heron, the HSI score is the geometric mean of all the variables. The ecological basis for this calculation is arguable, as this formula assumes that one variable compensates for another (i.e., you can get moderate HSI when one variable is low and another is high - they cancel each other out).

An inter-agency team that was charged with evaluation of the HSI approach for evaluation of the habitat assessment for the Forest Plan for the Tongass National Forest concluded that

> *"while superficially giving the appearance of a model based on cause-and-effect relationships, the critical linkages are abstract and do not have biological or ecological underpinnings"* (Hanley et al. 1985).

Indeed, Hanley et al. (1985) go on to conclude that the fundamental assumption of correlation between model results and habitat capacity is untestable. Roloff and Kerhohan (1999) found that none of the 58 existing HSI models that were tested had been validated, and correlations that have been noted may be spurious.

A second major concern is the amount of effort required for the Transect method versus the others, and the ability to adequately sample the range of variability in individual model parameters and variability within habitat conditions. Clark and Lewis (1983) attributed poor HSI model performance with sampling in a limited range of habitat conditions, and Bender et al. (1996) found poor HSI model performance resulting from inadequate consideration of data variability.

The weakest component of most HEP analyses is inadequate consideration of input data variability and how variability affects final HSI output interpretation (Roloff and Kerhohan 1999). Typically, the resources do not exist to thoroughly sample each habitat cover-type, and capture the variability within these cover-types. Thus, statistical means are often based on small sample sizes. Hence, a method that allows the greatest number of sample plots per unit of effort can provide an estimate with greater reliability than a method that allows few sample plots per unit of effort, even if the method is more quantitative.

For example, in the Transect method in this study, measurements of tree canopy in the North Satus unit averaged 34 percent, with a range of 10 to 70 percent. Based on a sample size of 5 plots, it would be hard to argue that these field measurements would be superior to visual estimates on 25 plots. The latter would be the number of plots that could be visually sampled using the Yakama method with the same amount of effort as the 5 plots using the Transect method.

The strongest argument in favor of the Transect method is repeatability, as trained biologists should be able to make the habitat variable measurements in a repeatable fashion. However, trained observers can also make visual estimates of variables in a repeatable fashion, especially since many of the variables are categorical (see Cook and Stubbendieck 1986).

In summary, while the Transect method would appear to be more precise and repeatable, the underlying assumptions of the quantitative models make them no more reliable than the Delphi models on which they are based. Second, the greater efficiency of collecting data using the Yakama method and the Delphi method allows a much larger number of sample plots, and increased reliability of the final HSI values.

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FIGURES AND TABLES

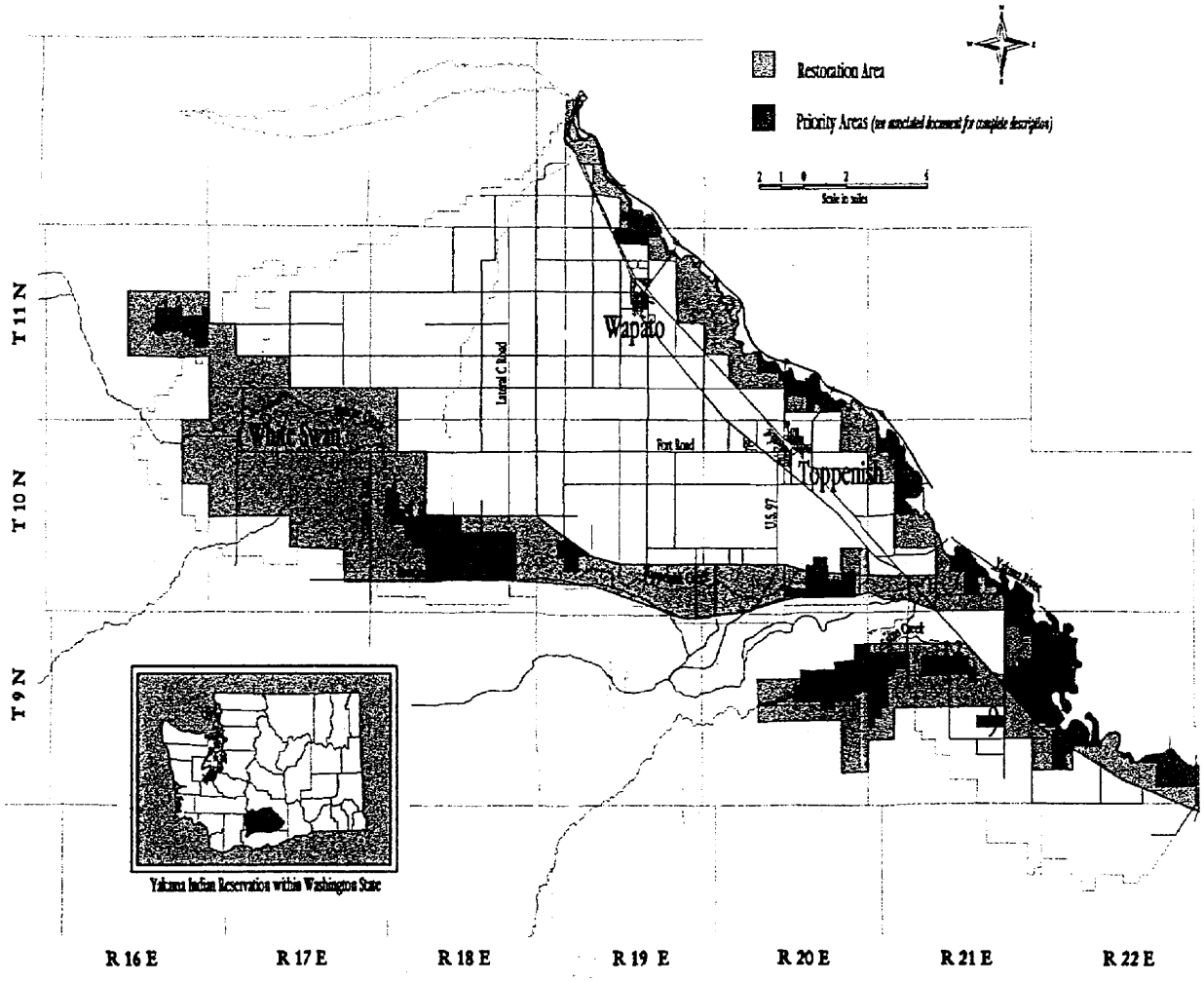

Figure 1. Regional Map, Yakama Nation Wildlife Mitigation Areas.

Table 1. Cover-type acreages in Wildlife Management Areas, provided by the Yakama Nation and used in the 1999 Yakama Nation HEP analysis.

	Satus	Lower Satus	Wanity Slough	Toppenish Creek	Wapato	Zimmerman	Mosebar Pond	TOTAL
UPLAND AND RIPARIAN								
Riparian Forest	481	168	0	10	207	4	41	911
Riparian Forest - Exotic	3	0	0	0	0	0	0	3
Riparian Herb/Forest	9	0	0	0	0	0	0	9
Riparian Shrub	206	89	18	25	39	1	19	397
Riparian Shrub - Exotic	659	114	16	165	12	0	34	999
Riparian Herb	462	21	38	62	31	4	65	683
Riparian Herb - Exotic	0	10	0	4	0	0	44	58
Shrub Steppe - Grasslands	1,682	2152	270	292	147	257	121	4,921
Shrub Steppe - Exotic	0	100	0	37	47	0	0	184
Agriculture - Pasture	146	954	8	368	223	1	63	1,762
Agriculture - Crop	70	0	0	135	0	0	0	205
WETLANDS								
Lacustrine	0	0	0	1	1	0	21	23
Riverine	83	59	11	14	30	4	0	201
Riverine - Exotic	0	0	0	0	0	4	0	4
Perennial Open Water	285	0	0	0	0	0	0	285
Palustrine Emergent	214	6	0	123	3	139	24	509
P. Unconsolidated Bottom	174	21	0	0	30	0	0	225
Buildings	0	0	0	0	0	20	0	20
TOTAL	4,479	3,696	364	1,108	776	430	434	11,401

Table 2. Cover-type acreages by Wildlife Management Areas used in the 1999 Yakama Nation HEP analysis.

	Satus	Lower Satus	Wanity Slough	Toppenish Creek	Wapato	Zimmer man	Mosebar Pond	Total
Upland and Riparian								
Riparian Forest	493	168	0	10	207	4	41	923
Riparian Shrub	864	203	34	190	51	1	53	1396
Riparian Herb	463	31	38	66	31	4	109	742
Shrub-Steppe Grassland	1682	2252	270	329	194	257	121	5105
Agriculture-pasture	146	954	8	368	223	1	63	1763
Agriculture-crop	70	0	0	135	0	0	0	205
Wetlands								
Lacustrine	0	0	0	1	1	0	21	23
Riverine	83	59	11	14	30	8	0	205
Palustrine Open Water	285	0	0	0	0	0	0	285
Palustrine Emergent	214	6	0	123	3	139	24	509
Palustrine Unconsolidated Bottom	174	21	0	0	30	0	0	225
Buildings	0	0	0	0	0	20	0	20
Total (Acres)	4474	3694	361	1236	770	434	432	11,401

Table 3. Description of cover-types used in Yakama Nation 1999 HEP analysis.

Cover-type	GIS Code	FWS Code	Description
UPLAND / RIPARIAN			
Riparian Forest	3	F	cottonwood and willow, - >30 % tree cover
Riparian Shrub	1	S	willow, red osier dogwood,
Riparian Shrub/Herb	¼	S/H	riparian shrub with at least 25% herb cover
Riparian Herb	4	H	annual and/or perennial forbs
Shrub-Steppe-Grassland	9	SSG	sagebrush, rabbit brush, hop sage > 25%, Great Basin Rye
Grassland	9	G	Great Basin Rye, shrubs < 25%
Agriculture – crop	2	Ag-c	current or recently abandon agricultural lands
Agriculture – crop – fallow	2	Ag-cf	pasture grasses
Agriculture – pasture	2	Ag-p	crops - corn, beans, etc.,
Agriculture – pasture fallow	2	Ag-pf	weeds, pasture grasses, cheat grass
WETLANDS			
Lacustrine	6	L	perennial open water >20 acres, >4 feet deep
Riverine	7	R	perennial flowing water
Palustrine Open Water		POW	open water <20 acres, < 4 feet deep in mid summer
P. Aquatic Bed	6	PAB4	rooted vascular plants - yellow water lily
P. Emergent – Persistent	8	PEM	bulrush, broad-leaved cattail
P. Unconsolidated bottom	5	PUB	sand, gravel, cobble, mud
DEVELOPMENTS			
Buildings, Roads, Parking		U	

Table 4. Species - habitat (cover-type) matrix indicating the HIS models used in the HEP analysis.

Species	Forest	Shrub	Herb	Shrub Steppe Grass-land	Wet-lands	Agri-culture	River	Open Water	Sand Gravel Cobble Mud
1. California quail	.	H	F	N/F	.	F	.	.	.
2. Canada goose	N	.	F	F	.	F	.	.	F
3. mallard	.	.	B	N	B	B	.	B	
4. spotted sandpiper	.	.	.	.	.	.	.	.	N/F
5. mink	N/F	N/F	.	.	F	.	F	.	F
6. western meadowlark	.	.	.	N/F	.	.	.	.	.
7. black-capped chickadee	N/F	.	.	.	.	.	.	.	.
8. yellow warbler	.	N/F	.	.	.	.	.	.	.
9. great blue heron	N	.	.	F	p	p	F	F	F
10. downy woodpecker	N/F	.	.	.	.	.	.	.	.
Total Number of Species	5	3	3	5	2	3	2	2	4

N = Nesting Habitat
H = Hiding Habitat
F = Foraging Habitat
B = Brood Rearing Habitat
N/F = Nesting and Foraging Habitat
p = present in habitat and could be modeled for habitat

Table 5. Wildlife HEP models, Yakama Nation HEP analysis, with HSI formulas stated in EXCEL spreadsheet protocol.

California Quail

Authors: Schroeder, Richard, USFWS Date: 1978
Habitats: Shrub, Pasture, Shrub-Steppe-Grass, Riparian Herb
Code: S, Ag-p, Ag-pf, SSG, H

HSI Foraging & Breeding = V1 + V2 + (V3 x V4 x V5) ^0.333

V1 – percent cover grass and herbs
V2 – average shrub height
V3 – distance to escape cover
V4 – diameter or width of escape cover patches
V5 – distance between escape cover patches

Canada Goose

Author: DeWard, unpublished review copy, modified to include forest cover Date: 1990
Habitats: Sand/gravel/cobble/mud, shrub-steppe-grassland, pasture, riparian herb, lacustrine, forest
Codes: SGCM, SSG, Ag-p, Ag-pf, H, L, POW, F

Changed in this report by RS Fleming to a nesting **OR** foraging model.

$$\text{HSI Nesting} = [Vi \times \frac{(V3 + V4)}{2}]^{0.5}$$

$$\text{HSI Foraging} = \frac{(V3 + V4)}{2}]^{0.5}$$

V1 – presence or absence of mature trees
V3 – distance between nesting sites and brood rearing areas
V4 – distance from human disturbance

Mallard

Author: Ashley, modified for Central Washington from Rasmussen and Wright, 1990 Date: 1999
Nesting Habitats: herb, grassland, shrub-steppe-grassland
Codes: H, G, SSG

$$\text{HSI Nesting} = [\frac{2V3 + V4}{3} \times V5]^{0.5} \times V6$$

Brood Rearing Habitats: emergent wetlands, lacustrine, palustrine emergent
Code: H, G, SSG, PEM, PAB4, POW, L

HSI Brood Rearing = V7 x V8 x V9

Table 5. Continued.

V3 – herb and shrub percent cover within 300 feet of shoreline
V4 – herb and shrub percent cover from 300 to 600 feet from shoreline
V5 – height of nesting cover
V6 – distance from human disturbance
V7 – ration of emergent vegetation to open water
V8 – distance between nesting and brood rearing areas
V9 – water regime

Spotted Sandpiper

Author: Dorsey, G.L., unpublished FWS review copy Date: 1990
Habitats: Sand-gravel-cobble-mud
Codes: SGCM

$$\text{HSI Foraging \& Breeding} = \frac{V1 + V2 + V3}{3}$$

V1 – percent cover of herbs less than 2 feet high
V2 – distance from nesting sites to open water or river
V3 – percent cover of organic debris

Mink

Author: Allen, A.W. Date: 1986
Habitats: Riverine, emergent, forest, shrub, sand-gravel-cobble-mud
Code: R, PEM, PAB4, F, S, SGCM

$$\text{HSI Foraging – Forest and Shrub} = \text{Min}(1.0, \frac{V2 + V3 + V4}{2}) + V5$$

$$\text{HSI Foraging – Emergent Wetlands (PEM, PAB4)} = \frac{(4 \times V4) + V5}{5}$$

$$\text{HSI Foraging – Riverine and SGCM} = (V5 \times V6)^{0.5}$$

V2 – percent cover of tree canopy
V3 – percent cover of shrub canopy
V4 – percent cover to emergent vegetation
V5 – percent tree cover within 330 feet of the shoreline
V6 – percent cover of trees and shrubs along the shoreline

Western Meadow Lark

Author: Schroeder & Sousa, modified Date: 1982
Habitats: Shrub-steppe-grassland and pasture
Codes: SSG, Ag-p, Ag-pf, G

$$\text{HSI Foraging \& Breeding} = (V1 \times V2 \times V3 \times V4)^{0.5} \times V5$$

Table 5. Continued.

V1 – percent cover of herbs and grass
V2 – percent cover of grass
V3 – average height of her and grass cover
V4 - distance to perch sites
V5 – percent shrub cover

Black-capped Chickadee

Author: Schroeder Date: 1983a
Habitats: Forest
Code: F

HSI Foraging & Breeding = lowest value for V1, V2, V3

In practice = V1 x V2 x V3 does not to exceed 1.0

V1 – percent tree cover
V2 – average height of trees
V3 – number of snags 4 to 10 inches in diameter per acre

Yellow Warbler

Author: Schroeder Date: 1982
Habitats: Shrub
Codes: S

HSI Foraging & Breeding = (V1 x V2 x V3)^0.333

V1 – percent cover of deciduous shrubs
V2 – average height of deciduous shrubs
V3 – percent cover of hydrophytic shrubs

Great Blue Heron

Author: Short and Cooper, modified to include forest nesting Date: 1985
Habitats: Nesting: forest
Code: F
Foraging: sand-gravel-cobble-mud, shrub-steppe-grassland, riverine, lacustrine, pasture
Code: SGCM, SSG, R, L, POW, Ag-p, Ag-pf

HSI - Nesting = (V1 x V2 x V3 x V4 x V5 x V6)^0.5

HSI – Foraging (all other cover types) = (V1 x V2 x V3)

Table 5. Continued.

V1 – distance between nesting and feeding sites
V2 – forage quality
V3 – distance to human disturbance
V4 – availability of nesting sites
V5 – disturbance at nesting sites
V6 – actual and potential distance to nesting sites from foraging areas

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Downy Woodpecker

Author: Schroeder Date: 1983b
Habitats: Mature forest
Codes: F

HSI Foraging & Breeding = lowest value V1 or V2

In practice V1 x V2 seldom exceeds 1.0. In the cases where it exceeds 1.0, the value was reset to 1.0.

V1 – basal area per acre
V2 – number of snags from 7 to 9 inches in diameter per acre

Table 6. Number of sample plots by cover-types sampled on Wildlife Management Areas, Yakama Nation 1999 HEP analysis.

Management Area	F	S	H	SSG	G	Ag c	Ag f	L	POW	R	PAB4	PEM	SGCM	Total
Satus Creek	3	2	2	1	2	0	2	1	1	1	3	1	2	21
North Satus Creek	1	0	0	2	0	0	1	0	0	1	0	0	1	6
Lower Satus Ck	1	2	1	1	1	1	2	0	0	2	0	1	11	13
Wanity Slough	0	1	0	0	0	0	4	0	0	1	0	0	0	6
Toppenish Pump	1	1	0	1	0	0	3	0	0	1	0	1	0	8
Wapato Slough	2	1	0	1	2	1	0	0	0	1	0	1	0	9
South Lateral A (Zimmerman's)	1	0	0	1	2	0	2	0	1	1	1	4	0	13
Mosebar Pond	0	1	1	1	0	1	3	1	1	0	0	1	0	10
Total	9	8	4	8	7	3	17	2	3	8	4	9	4	86

Table 7. Calculation of Habitat Units for Lower Satus Wildlife Management Area in 1999 HEP.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	1		**1.00**			**0.80**		**0.90**		**0.00**	**1.00**
Shrub	2	**1.00**				**0.65**			**0.45**		
Herb	1	**1.00**	**0.90**	**0.40**							
SSG	2	**1.00**	**1.00**	**0.60**			**0.15**			**0.25**	
Ag-c/f	1	**1.00**								0.10	
Ag-p/f	2	**1.00**	**1.00**	**0.70**			**0.45**			**0.25**	
Lake	0		0.70	0.30						0.35	
Riverine	2					**0.30**				**0.65**	
POW	0		0.70	0.20						0.30	
PEM	1			**0.90**		**0.80**					
PUB	1		**1.00**		**0.70**					**1.00**	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	168		168			134		151		0	168	622
Shrub	203	203				132			91			426
Herb	31	31	28	12								71
SSG	2252	2252	2252	1351			338			563		6756
Ag-c/f	954	954								95		1049
Ag-p/f	0	0	0	0			0			0		0
Lake	0		0	0						0		0
Riverine	59					18				38		56
POW	0		0	0						0		0
PEM	6			5		5						10
PUB	21		21		15					21		57
Total	3694	3440	2469	1369	15	289	338	151	91	718	168	9048

Table 8. Calculation of Habitat Units for Mosebar Pond Wildlife Management Area in 1999 HEP.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	0		0.74			0.84		0.78		0.18	0.69
Shrub	1	**1.00**				**0.80**			**0.40**		
Herb	1	**1.00**	**0.70**	**0.00**							
SSG	0	0.98	0.82	0.36			0.22			0.23	
Ag-c/f	0	0.70								0.10	
Ag-p/f	3	**1.00**	**0.70**	**0.43**			**0.23**			**0.27**	
Lake	1		**0.70**	**0.30**						**0.20**	
Riverine	0					0.35				0.80	
POW	1		**0.70**	**0.30**						**0.10**	
PEM	1			**0.90**		**0.90**					
PUB	1		**0.70**	**0.20**	**0.70**					**0.30**	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	41		30			34		32		7	28	132
Shrub	53	53				42			21			117
Herb	109	109	76	0								185
SSG	121	119	99	44			27			28		316
Ag-c/f	63	44								6		50
Ag-p/f	0	0	0	0			0			0		0
Lake	21		15	6						4		25
Riverine	0					0				0		0
POW	0		0	0						0		0
PEM	24			22		22						43
PUB	0		0		0					0		0
Total	432	325	221	71	0	98	27	32	21	46	28	869

Table 9. Calculation of Habitat Units for Satus Wildlife Management Area in 1999 HEP.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	3		**0.70**			**0.97**		**0.67**		**0.17**	**0.53**
Shrub	2	**1.00**				**0.65**			**0.60**		
Herb	2	**1.00**	**0.70**	**0.00**							
SSG	3	**1.00**	**0.70**	**0.37**			**0.15**			**0.33**	
Ag-c/f	0	0.70								0.10	
Ag-p/f	2	**1.00**	**0.70**	**0.35**			**0.70**			**0.30**	
Lake	1		**0.70**	**0.30**						**0.40**	
Riverine	1					**0.60**				**0.10**	
POW	1		**0.70**	**0.30**						**0.10**	
PEM	1			**0.90**		**0.70**					
PUB	2		**0.70**		**0.70**					**0.55**	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	493		345			478		330		84	261	1499
Shrub	864	864				562			518			1944
Herb	463	463	324	0								787
SSG	1,682	1682	1177	622			252			555		4289
Ag-c/f	146	102								15		117
Ag-p/f	70	70	49	25			49			21		214
Lake	0		0	0						0		0
Riverine	83					50				8		58
POW	285		200	86						29		314
PEM	214			193		150						342
PUB	174		122		122					96		339
Total	4474	3181	2217	925	122	1239	301	330	518	807	261	9903

Table 10. Calculation of Habitat Units for Toppenish Creek Wildlife Management Area in 1999 HEP.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	1		**1.00**			**0.70**		1.00		**0.00**	**0.80**
Shrub	1	**1.00**				**0.90**			**0.80**		
Herb	0	1.00	0.75	0.10							
SSG	1	**1.00**	**1.00**	**0.10**			**0.00**			**0.10**	
Ag-c/f	0	0.70								0.10	
Ag-p/f	3	0.97	0.70	0.27			0.27			0.23	
Lake	0		0.70	0.30						0.35	
Riverine	1					**0.20**				**0.70**	
POW	0		0.70	0.20						0.30	
PEM	1			**0.90**		**0.70**					
PUB	0		0.76		0.70					0.50	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	10		10			7		10		0	8	35
Shrub	190	190				171			152			513
Herb	66	66	50	7								122
SSG	329	329	329	33			0			33		724
Ag-c/f	368	258								37		294
Ag-p/f	135	131	95	36			36			31		329
Lake	1		1	0						0		1
Riverine	14					3				10		13
POW	0		0	0						0		0
PEM	123			111		86						197
PUB	0		0		0					0		0
Total	1236	974	484	187	0	267	36	10	152	111	8	2228

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	1		**1.00**			**0.80**		**0.90**		**0.00**	**1.00**
Shrub	2	**1.00**				**0.65**			**0.45**		
Herb	1	**1.00**	**0.90**	**0.40**							
SSG	2	**1.00**	**1.00**	**0.50**			**0.15**			**0.25**	
Ag-c/f	1	**1.00**								0.10	
Ag-p/f	2	**1.00**	**1.00**	**0.70**			**0.45**			**0.25**	
Lake	0		0.70	0.30						0.35	
Riverine	2					**0.30**				**0.65**	
POW	0		0.70	0.20						0.30	
PEM	1			**0.90**		**0.80**					
PUB	5		**1.00**		**0.70**					**1.00**	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	0		0			0		0		0	0	0
Shrub	34	34				22			15			71
Herb	38	38	34	15								87
SSG	270	270	270	135			41			68		783
Ag-c/f	8	8								1		9
Ag-p/f	0	0	0	0			0			0		0
Lake	0		0	0						0		0
Riverine	11					3				7		10
POW	0		0	0						0		0
PEM	0			0		0						0
PUB	0		0		0					0		0
Total	361	350	304	150	0	25	41	0	15	75	0	961

Table 12. Calculation of Habitat Units for Wapato Wildlife Management Area in 1999 HEP.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	2		**0.70**			**1.00**		**0.80**		**0.05**	**0.50**
Shrub	1	**1.00**				**1.00**			**0.50**		
Herb	0	1.00	0.75	0.10							
SSG	3	**1.00**	**0.70**	**0.50**			**0.35**			**0.30**	
Ag-c/f	1	**1.00**								0.10	
Ag-p/f	0	0.99	0.75	0.35			0.43			0.25	
Lake	0		0.70	0.30						0.35	
Riverine	1					**0.60**				**1.00**	
POW	1		0.70	**0.90**		**0.70**				0.30	
PEM	0			0.64		0.64					
PUB	0		0.76		0.70					0.50	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	207		145			207		166		10	104	631
Shrub	51	51				51			26			128
Herb	31	31	23	3								57
SSG	194	194	136	97			68			58		553
Ag-c/f	223	223								22		245
Ag-p/f	0	0	0	0			0			0		0
Lake	1		1	0						0		1
Riverine	30					18				30		48
POW	0		0	0						0		0
PEM	3			2		2						4
PUB	30		23		21					15		59
Total	770	499	327	102	21	278	68	166	26	136	104	1726

Table 13. Calculation of Habitat Units for Zimmerman Wildlife Management Area in 1999 HEP.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	1		**0.70**			**0.40**		**0.60**		**0.70**	**0.80**
Shrub	0	1.00				0.74			0.56		
Herb	0	1.00	0.75	0.10							
SSG	3	**0.90**	**0.90**	**0.13**			**0.17**			**0.13**	
Ag-c/f	0	0.70								0.10	
Ag-p/f	3	**1.00**	**0.80**	**0.10**			**0.43**			0.25	
Lake	0		0.70	0.30						0.35	
Riverine	1					**0.20**				**0.70**	
POW	1		**0.70**	0.20						**0.70**	
PEM	1			**0.38**		**0.52**					
PUB	0		0.76		0.70					0.50	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	4		3			2		2		3	3	13
Shrub	1	1				1			1			2
Herb	4	4	3	0								7
SSG	257	231	231	33			44			33		573
Ag-c/f	1	1								0		1
Ag-p/f	0	0	0	0			0			0		0
Lake	0		0	0						0		0
Riverine	8					2				6		7
POW	0		0	0						0		0
PEM	139			53		72						125
PUB	0		0		0					0		0
Total	414	237	237	87	0	76	44	2	1	42	3	729

Table 14. Calculation of Habitat Units for All Wildlife Management Areas in the 1999 HEP analysis.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	9		0.74			0.84		0.78		0.18	0.69
Shrub	8	1.00				0.74			0.56		
Herb	4	1.00	0.75	0.10							
SSG	14	0.98	0.82	0.36			0.22			0.23	
Ag-c/f	3	0.70								0.10	
Ag-p/f	18	0.99	0.75	0.35			0.43			0.25	
Lake	2		0.70	0.30						0.35	
Riverine	8					0.35				0.80	
POW	3		0.70	0.20						0.30	
PEM	10			0.64		0.64					
PUB	5		0.76		0.70					0.50	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	923		683			775		720		166	637	2981
Shrub	1396	1396				1033			782			3211
Herb	742	742	557	74								1373
SSG	5105	5003	4186	1838			1123			1174		13324
Ag-c/f	1763	1234								176		1410
Ag-p/f	205	203	154	72			88			51		568
Lake	23		16	7						8		31
Riverine	205					72				164		236
POW	285		200	57						86		342
PEM	509			326		326						652
PUB	225		171		158					113		441
Total	11381	8578	5966	2373	158	2206	1211	720	782	1938	637	24568

Table 15. Calculation of Habitat Units for all the Wildlife Management Areas based on the 1990 HSI scores and 1990 acreages.

Average HSI scores using Yakama Method used in final HU calculations.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	0		1.00			1.00		0.90		0.90	0.90
Shrub	0	0.80				0.80			0.80		
Herb	0	0.80	0.50	0.50							
SSG	0	0.50	0.30	0.30			0.50			0.10	
Ag-c/f	0	0.60								0.00	
Ag-p/f	0	0.60	0.75	0.20			0.00			0.00	
Lake	0		0.70	0.60						1.00	
Riverine	0					0.70				1.00	
POW	0		0.70	0.60						1.00	
PEM	0			0.70		0.80					
PUB	0		0.90		1.00	0.80				0.00	

Habitat Units (HUs) for each species by cover-type.

Cover type	acres	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	Black-capped chickadee	Yellow warbler	Great blue heron	Downy woodpecker	Total HUs
Forest	923		923			923		831		831	831	4338
Shrub	1397	1118				1118			1118			3353
Herb	741	593	371	371								1334
SSG	4,909	2455	1473	1473			2455			491		8345
Ag-c/f	206	124								0		124
Ag-p/f	2120	1272	1590	424			0			0		3286
Lake	23		16	14						23		53
Riverine	201					141				201		342
POW	286		200	172						286		658
PEM	370			259		296						555
PUB	51		46		51					0		97
Total	11227	5561	4618	2712	51	2477	2455	831	1118	1832	831	22484

Table 16. Cover-types and acreages used in the 1990 and 1999 Yakama Nation HEP Analyses.

Cover-Types Description	YN GIS Code	Code in this Report	1990 Project Area (acres)	1999 Project Area (acres)	Percent Change
UPLANDS					
Riparian Forest	3	F	887	911	102.7
Riparian Forest – exotics	3	Fe	27	3	11.1
Riparian Forest – Herb	4/3	F/H	9	9	0.0
Riparian Shrub	1	S	397	397	0.0
Riparian Shrub - exotics	1	Se	999	999	0.0
Riparian Shrub - Herb	4/1	S/H	1		
Riparian Herb	4	H	683	683	0.0
Riparian Herb - exotics	4	He	58	58	0.0
Shrub-Steppe-Grass	9	SSG	4725	4921	104.1
Shrub-Steppe - exotics	9	SSGe	184	184	0.0
Agriculture - crop	2	Ag-c	206	205	99.5
Agriculture - pasture	2	Ag-p	2120	1763	83.2
WETLANDS					
Lacustrine- Pond	6	L – P	23	23	0.0
Palustrine Open Water	6	POW	286	285	99.6
Riverine	7	R	0201	201	0.0
Riverine – exotic	7	Re	0	4	
Emergent	8	PEM	156	295	189.1
Emergent - exotics	8	PEMe	214	214	0.0
Sand Gravel Cobble Mud	5	PUB	51	225	441.2
OTHER					
Buildings - Developments		D	20	20	0.0
Total			11,247	11,401	101.4

Table 17. Average HSI scores in the 1999 Yakama HEP using Delphi Method.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	lack-cappe chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	9		0.56			0.58		0.68		0.59	0.57
Shrub	8	0.56				0.34			0.45		
Herb	4	0.33	0.48	0.13							
Shrub steppe	6	0.44	0.19	0.23			0.46				
Grass	8		0.07	0.56			0.37			0.13	
Ag-c	1										
Ag-cf	2										
Ag-p	5	0.34	0.30				0.72				
Ag-pf	13	0.44	0.28				0.54				
Lake	2		0.55	0.25						0.25	
Riverine	8					0.43				0.61	
POW	3		0.60	0.73						0.70	
PEM	10		0.31	0.78		0.31				0.63	
PAB4	4			0.50							
PUB	5		0.17		0.60	0.13				0.63	

Table 18. Average HSI scores in the 1999 Yakama HEP using Yakama Method.

Cover type	n	California quail	Canada goose	Mallard	Spotted sandpiper	Mink	Meadow-lark	lack-cappe chickadee	Yellow warbler	Great blue heron	Downy woodpecker
Forest	9		0.74			0.84		0.78		0.18	0.69
Shrub	8	1.00				0.74			0.56		
Herb	4	1.00	0.75	0.10							
Shrub steppe	6	1.00	0.83	0.30			0.08			0.22	
Grass	8	0.96	0.81	0.41			0.22			0.24	
Ag-c	1	0.10								0.10	
Ag-cf	2	1.00									
Ag-p	5	1.00	0.70	0.18			0.46			0.34	
Ag-pf	13	0.99	0.77	0.42			0.35			0.22	
Lake	2		0.70	0.30						0.35	
Riverine	8					0.35				0.80	
POW	3		0.70	0.20						0.30	
PEM	10			0.64		0.64					
PAB4	4			0.80		0.38					
PUB	5		0.76		0.70					0.50	

Table 19. Comparison of overall HSI values from the Delphi and Yakama Methods as part of the 1999 HEP assessment. Tabled values are overall averages by species.

Species	Sample size	Delphi	Yakama
California quail	5	0.42	1.00
Canada goose	9	0.36	0.72
Mallard	7	0.45	0.46
Spotted sandpiper	1	0.60	0.70
Mink	4	0.42	0.64
Western Meadowlark	4	0.52	0.29
Black-capped chickadee	1	0.68	0.78
Yellow warbler	1	0.45	0.56
Great blue heron	5	0.44	0.40
Downy woodpecker	1	0.57	0.70
Total	38	0.44	0.61

Table 20. Comparison of effort required for HEP analysis using the Delphi, Yakama and Transect methodologies. Tabled values are effort required to sample 100 plots.

Phase/Task	Delphi	Yakama	Transect	Notes
Field Preparation				
Scoping	5	5	5	
Species selection	1	1	1	
Habitat mapping				1
Model building	4	10	10	2
Field prep.	2	2	2	
Field Sampling				
Travel time	21	16	40	
Data collection	12	6	222	3
Computation Tasks				
Create spreadsheets	0	5	5	
Data analysis	1	4	4	
Data summary	1	1	1	
Total Effort	47	50	290	

Notes:
1 Would be the same for all methods
2 We assume 10 species, with 5 new models and 5 models unaltered
3 Values are for a three-person team

APPENDIX A

Sampling Plan

Table A-1. Participants, Yakama Nation HEP Analysis, August 1999.

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Natural Resources Division, Kalispel Tribe

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Jim **STEVENSON**
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Bill **STEWART**
US Fish and Wildlife Service

Theodora **STRONG**
Wildlife Resource Management, Yakama Nation

Haace **St. MARTIN**
Burns Paiute Tribe

Richard **TEMPLE**

Table A-2. Participation, Yakama Nation HEP Analysis, August 1999.

August	6	9	10	11	12	13	17	18	19	20*
Ashley	X			X	X					
Auld		X	X					X	X	
Barns								X		
Feen					X					
Fleming	X	X	X	X	X	X	X	X	X	X
Fraser		X			X					
Hames	X	X	X	X	X	X	X	X	X	X
Holmes		X	X					X	X	
James				X	X	X				
King				X						
Larsen									X	
Lewis			X	X						
Nunn				X	X					
Palmer			X	X						
Stevenson		X			X					
Stewart				X						
Strong									X	
St. Martin				X	X					
Temple		X								
TOTAL	3	7	6	10	9	3	2	5	7	2

* Office

APPENDIX B

Delphi Method

Table B-1. Delphi Word Models for Species, Yakama Nation HEP Analysis.

The word models below have been adapted for use in the evaluation of lands in the Yakima River Valley near Toppenish, Washington. Some of these lands remain near natural riparian forests and wetlands. Other lands have been in irrigation agriculture for many years. The Yakama Nation is in the process of restoring the agricultural lands as wildlife habitat. The descriptions below are guides for assigning a single habitat rating (HSI) for each species at each sample site. In this exercise, the intention is a quick evaluation of the habitat at a sample station or plot. The plot would be approximately one acre in area (a radius of 118 feet) centered, or off centered in some cases, upon the designated station.

The description for the HSI values provide reference points. Values assigned in the filed can range from 0.0 (no habitat value) to 1.0 (ideal habitat). Values should be limited to increments of 0.1 (i.e. do not assign 0.675 because we will enter 0.7)

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1. Canada Goose

Cover-Type: Nesting: Riparian Forest (mature cottonwood with open branch structure)
Foraging: Bare (sand gravel), Mud (PAB), Fallow Pasture, Shrub-Steppe/Grasslands, Riparian Herb, Lacustrine, Open Water (POW), Emergent (PEM).

Description: The Canada goose model is for the Yakima Valley region where the geese nest in mature trees within the riparian corridor. Trees or snag must be of sufficient size to support a nest structure and have and open branch structure. When the goslings leave the nest they are lead to an area of with open water, emergent vegetation for cover, and easily accessible herb/grass foraging areas. Both nesting and brood rearing areas have minimal disturbance by human or domestic pets.

HSI Values:

1.0 Riparian forest with some trees or snags >8 inches dbh for nesting. Short grass foraging areas for broods <1 mile of nesting areas. Human disturbance >1/2 mile from foraging and nesting areas.

0.5 Mature trees for nesting limited, few snags. Short grass brood foraging areas either limited or 1 to 2 miles from nesting area. Human disturbance 1/4 to 1/2 miles away.

0.2 Few mature trees for nesting. Brood foraging areas not apparent or >2 miles away. Human disturbance <1/4 miles away.

0.0 No suitable habitat.

---

2. Mallard

Cover-Type: *Nesting:* Riparian herb, Grassland, Shrub-grass, Shrub, and Shrub Steppe.
Rearing: Emergent (PEM), Lacustrine, Open Water (POW), Water Lily (PAB).

Description: Nesting habitat is shrub-steppe/grassland and riparian herb cover in proximity to riparian herb habitats for subsequent brood rearing. Broods are moved to areas of emergent vegetation with open water.

HSI Values:

1.0 *Nesting:* Canopy cover within 300 feet of open water >75 % and from 300 to 600 feet, cover >75 %. Nesting vegetation is herbaceous or shrub cover from 18 to 24 inches high. Cover provides horizontal and vertical screening. *Brood:* Canopy cover from 40 to 60 % emergent vegetation (PEM) and/or root floating (water lily PAB)) with open water being the remainder. Carp absent. Intermittently exposed to semi permanently flooded.

0.5 *Nesting:* Canopy cover within 300 feet of the water 40% and from 300 to 600 feet 40%. Nesting cover 12-15 inches high or 25-36 inches high. *Brood* cover 20 % open water or 80 % open water. Permanently flooded. Flowing water maintains moderate water clarity.

0.2 *Nesting* cover within 300 feet of water 20% and from 300 to 600 feet, 20 %. Vegetation <12 inches high or >36 inches high. *Brood:* Open water or solid rooted lily or emergent vegetation. Still or sluggish water, water opaque.

0.0 No suitable habitat.

---

3. California Quail

Cover-Type: Riparian Shrub, Riparian Herb, Fallow Pasture, Pasture, Shrub-Steppe/Grasslands

Description: Forages on seeds and insects in herb and grassy areas with escape cover near by.

HSI Values:

1.0 Herbs and grasses comprise 55 to 70 % of ground cover. Escape cover is shrubs >7 feet high. Distance to escape cover <125 feet. Patches of escape cover 10 to 20 feet in diameter and distance between patches from 100 to 200 feet.

0.5 Herbs and grass cover 25 %. Shrubs >4 foot tall. Distance to escape cover (shrubs) >250 feet. Distance between escape cover patches either <50 feet or >300 feet.

0.2 Herb and grass cover <10 %. Shrubs <3 feet in height. Distance to escape cover patches >500 feet.

0.0 No suitable habitat.

---

4. Great Blue Heron

Cover Type: Riparian Forest, Bare (Sand/Gravel, Mud (PAB), Grassland, Riverine, Lacustrine, Open Water (POW), Emergent (PEM) ??

Description: Forages along steams, emergent wetland, grasslands and agricultural fields. Tolerates moderate disturbance. In the Yakama Project Area, nests are in riparian forest adjacent to streams or wetlands. Disturbance at either nest sites or foraging areas reduces use.

HSI Values:

1.0 Optimal foraging is in clear water streams, ponds, sloughs, and emergent wetlands, agricultural fields. Nesting trees <1/2 mile from foraging areas. No substantial human or domestic pet disturbance within 1/4 mile.

0.5 Water not clear in foraging areas. Palustrine trees and or shrubs crowd the stream/pond bank. Moderate disturbance within 1/4 mile. Nesting trees either marginal in size (< 8" dbh) or >5 mile from foraging areas.

0.2 Murky water. Appropriate foraging habitat scarce. Foraging area >6 miles from nesting area. Frequent human disturbance.

0.0 Either no foraging habitat, no nesting habitat, or persistent high levels of disturbance.

---

5. Spotted Sandpiper

Cover-Type: Sand Gravel Cobble Mud (Bare, PAB (mud)

Description: Nest in sparsely vegetated sand/gravel/cobble in braided stream channels. Only limited woody debris present. Nests close to the water. Forages along the waters edge and on mud banks.

HSI Values:

1.0 Herbs <2 feet high provide 10 to 50 % cover. Water <75 feet from nest sites. Organic debris (driftwood) <50 %. ground cover.

0.5 Herb cover 5 to 10 % or 50 to 75 %. From nest sites to water >200 feet. Organic debris >70 % cover.

0.2 Little herb cover or cover >70 % cover. Distance from nest site to water >250 feet. Ground cover mostly organic debris.

0.0 No suitable habitat.

---

6. Downy Woodpecker

Cover-Type: Riparian Forest

Description: Downy woodpeckers glean insects from the bark of trees and excavating into the bark or decaying wood to extract insects. Nests and forages in mature riparian forest. They excavate their nest cavities in dying or decaying trees.

HSI Values:

1.0 Forages and nests in mature riparian forest (trees >12" dbh). Density of snags >5 per acre >6 inches dbh. Basal area of trees from 40 to 90 sq. ft per acre and snags density >5 per acre. Riparian forest in the project area are assumed to meet these requirements. A territory must have >10 acres of suitable habitat.

0.5 Basal area of trees >30 sq. ft. per acre and density of snags >2 per acre.

0.2 Basal area of trees >20 sq. ft. per acre and density of snags >1 per acre.

0.0 No nesting or foraging habitat present.

---

7. Black-Capped Chickadee

Cover-Type: Riparian Forest
Description: Nests in cavities in trees in mature riparian forest with at least 2 snags per acre. Forages in riparian forest and shrub. Gleans food from foliage, branches, twigs, and bark.

HSI Values:

1.0	Mature riparian forest with trees 50 to 75 % cover and tree height >50 feet. Density trees or snags with cavities (4 to 8 inches dbh) >2 per acre.
0.5	Tree canopy >50 % and trees >20 feet in high. At least 1 snag per acre.
0.2	Tree canopy >10 % cover and trees >10 feet in high. Snags density > 0.2 per acre.
0.0	No habitat present.

---

8. Yellow Warbler

Cover-Type: Riparian Shrub
Description: Forages and nests in tall riparian (hydrophytic) shrubs. All of the riparian shrubs in the study areas are considered hydrophytic. Gleans and hawks for insects.

HSI Values:

1.0	Hydrophytic shrub from 60 to 80 % cover and >6 feet high.
0.5	Hydrophytic shrub <30 % cover and herbs >3 feet high.
0.2	Hydrophytic shrubs <10 % cover and herbs <18 inches high.
0.0	No nesting or foraging habitat present.

---

9. Meadowlark

Cover Types: Shrub-Steppe/Grassland/Fallow Pasture/Pasture
Description: Nests and forages in grasslands and open shrub-steppe. Perch sites on shrubs or fence posts in proximity to nest and foraging areas.

HSI Values:

1.0	Grass/herb canopy cover 65%, of which grasses are 65%. Average height of herbs is from 6-13 inches. Shrub cover <10 %. Distance to perch sites <100 feet
0.5	Herb canopy <50 %, of which 50 % is grass. Average height of herb canopy less than 5 inches or more than 20 inches. Suitable perch sites >150 feet away. Shrub canopy >20 %.
0.2	Herb cover <25 %, of which grass is <25 %. Distance to perch sites is >200 feet. Shrub canopy >30 %.
0.0	No suitable habitat.

---

10. Mink

Cover-Type: Riverine, Emergent Wetland, Riparian Forest, Riparian Shrub, Bare (sand and gravel), PAB (mud)

Description: Mink are very adaptable and can effectively use shoreline habitats that provides adequate shelter and structural complexity as long as adequate food supplies are available. Mink use crustaceans (crawfish), fish, amphibians, waterfowl, and small mammals and usually forage on the most abundant food source. In the project area, waterfowl are a major source of food. Human disturbance and/or human simplification of the riparian shoreline can degrade riparian habitat.

HSI Values:

1.0	Tree and/or shrub cover along riparian corridor >75 %. Emergent vegetation 50 to 75 percent. Surface water present >75 % of year.
0.5	Tree and/or shrub cover along riparian corridor >50 %. Emergent cover >50 %. Surface water present >50 % of the year.
0.2	Tree and/or shrub cover along riparian corridor <20 %. Surface water present <30 % of the year.
0.0	No tree or shrub cover in riparian corridor. Surface water only occasionally present.

Table B-2. Delphi Species HSI Sample Datasheet. **Plot:** _____

Serial: _____

Date: _____ **End Time:** _____ **Start Time:** _____ **Elapse (hrs):** _____

Observers: _____

Area: Satus (**S**), North Satus (**NS**), Lower Satus (**LS**), Wanity Slough (**WS**), Toppenish Pump (**TP**), Wapato (**W**), South Lateral A (**SLA**), Mosebar (**M**), Other

Location in Area: _____

Cover Type: **Forest** **Shrub** **Herb** **Herb/Forest** **Herb/Shrub** **Shrub/Steppe** **Ag-fallow** **Ag-pasture** **Lacustrine** **Riverine** OpenWater(**POW**) AquaticBed(**PAB**) **B**(SandGravelCobble) **PUB**(mud) Emergent(**PEM**) Palustrine Shrub (**PSS**) **Riverine/Shrub** **U**(developed) **Other:** _____

Add "**e**" if exotic comprise more that 50 % of the cover.

Hydrology of Stream or Wetland: absent or highly degraded, function restored, natural or near natural

Sample Area: 1 acre circular plot = 118 foot radius *1/4 acre circular plot = 59 foot radius*

Plot Number = Initial of Priority Area and sequential plot number. i.e. NS-7

Plot Number	_____	_____	_____	_____
GIS Cover Type	_____	_____	_____	_____
Alternate Type	_____	_____	_____	_____
End Time	_____	_____	_____	_____
Start Time	_____	_____	_____	_____
Net Time	_____	_____	_____	_____
Age of Stand (Years)	_____	_____	_____	_____
1. Canada Goose	_____	_____	_____	_____
2. Mallard	_____	_____	_____	_____
3. California Quail	_____	_____	_____	_____
4. Great Blue Heron	_____	_____	_____	_____
5. Spotted Sandpiper	_____	_____	_____	_____
6. Downy Woodpecker	_____	_____	_____	_____
7. Black-capped Chickadee	_____	_____	_____	_____
8. Yellow Warbler	_____	_____	_____	_____
9. Meadow Lark	_____	_____	_____	_____
10. Mink	_____	_____	_____	_____

APPENDIX C

Yakama Nation Method

Table C-1. Yakama Method Parameter used in 1991, Yakama Nation HEP Analysis.

	Model Parameter	Model Unit	Convert To	Calif quail	Canada goose	mallard	Sand piper	mink	meadow lark	chick adee	yellow warbler	grt blu heron	downy woodpk
1.	Grass & herbs - percent canopy cover		% cover	X									
2.	Shrubs - average height	cm	inches	X							X		
3.	Escape cover - distance to	m	feet	X									
4.	Escape cover patches - average diameter	m	feet	X									
5.	Escape cover patches - distance between	m	feet	X									
6.	trees mature – presence				X								
7.	brood area to nesting area – distance	m	feet		X								
8.	disturbance human – distance	m	feet		X	X							
	mallard ??					X							
9.	nest to emergent vegetation - distance	m	feet			X							
10.	residual cover – height	cm	inches			X							
11.	nesting vegetation - percent cover		% cover			X							
12.	ratio vegetation to open water					X							
13.	herbs < 2 ft - percent cover		% cover				X						
14.	nesting habitat to water – distance	cm	feet				X						
15.	debris organic <150 ft to water - % cover		% cover				X						
16.	water present - percent of year		%					X					
17.	Trees - percent cover		% cover					X		X			
18.	Shrub - percent cover		% cover					X	X				
19.	Emergent vegetation - percent cover		% cover					X					
20.	tree <100m of wetlnd edge - % cover		% cover					X					
21.	Vegetation along shoreline - % cover		% cover					X					
22.	Herbs - percent cover		% cover						X				
23.	Grasses and herbs - percent cover		% cover						X				
24.	Herbs - average height	cm	inches						X				
25.	Perches sites - distance to	m	feet						X				
26.	Trees - average height	m	feet							X			
27.	Snags - number per acre > 10-25 cm	convert								X			
28.	Shrubs deciduous - percent cover		% cover								X		
29.	shrubs hydrophytic - percent cover		% cover								X		
30.	nest sites - distance to foraging areas	m	feet									X	
31.	nest sites to potential sites – distance to	m	feet									X	
32.	foraging habitat quality											X	
33.	disturbance human - foraging areas											X	
34.	nest sites - availability											X	
35.	disturbance human - nest sites											X	
36.	trees - basal area per acre		sq in./ac										X
37.	snags - number per acre> 15cm dbh	convert	per acre										X

Table C-2. Yakama Method Parameters Sampling Order, Yakama Nation HEP Analysis.

	Model Parameter	Proposed Unit
	TREES - riparian forest only	
1	Snags/ac. 4 to 8" dbh	#/ac.
2	Snags/ac. >6" dbh	#.ac
3	Basal area/ac.	sq. in./ac.
4	Tree canopy cover	percent
5	Average tree height	feet
6	Mature trees present	yes/no
	SHRUBS - riparian forest, riparian shrub, shrub-steppe	
7	Shrub canopy cover	percent
8	Deciduous shrub cover	percent
9	Hydrophytic shrub cover	percent
10	Average shrub height	feet (decimal)
	HERBS and GRASS - riparian forest, riparian shrub, riparian herb, shrub-steppe, agriculture	
11	Herb cover	percent
12	Grass cover	percent
13	Ratio of grass to herb	ratio
14	Cover herbs < 2 feet height	percent
15	Average herb height	feet
	EMERGENT PLANTS - PEM	
16	Cover of emergent plants	percent
	SAND, GRAVEL, COBBEL, MUD - (B)	
17	Cover by organic debris and driftwood	percent
	SPECIES SPECIFIC PARAMETERS	
	California Quail - riparian shrub, riparian herb, shrub-steppe	
18	distance to escape cover - (dense vegetation > 8" high) ???	feet
19	average diameter of patches escape cover	feet
20	distance between escape cover patches	feet
	Canada Goose - riparian herb, shrub-steppe, agriculture, sand/gravel	
21	quality of nesting habitat	score
22	distance from nesting to brood areas	feet
23	distance from nest to human disturbance	feet

Table C-2. Continued.

	Mallard - riparian herb, emergent, shrub-steppe, agriculture, riverine, lacustrine	
24	??	
25	??	
26	distance from nest site to emergent plants	miles
27	height of residual cover	feet
28	cover of nesting habitat	Percent
29	level of human disturbance	score
30	ratio of emergent vegetation to open water	ratio
	Spotted Sandpiper - sand/gravel	
31	distance of nest site to water	feet
	Mink – riparian forest, riparian shrub, emergent, riverine, sand/gravel	
32	open water during the year	percent
33	trees and shrubs cover <330" wetland edge.	percent
34	tree and shrub cover along shoreline	percent
	Western Meadowlark - shrub-steppe	
35	distance to perch sites	feet
	Great Blue Heron - riparian forest, shrub-steppe, riverine, lacustrine, sand/gravel	
36	distance foraging area to potential nest sites	miles
37	foraging habitat quality	score
38	level of human disturbance near potential feeding areas	score
39	availability of potential nest sites	score
40	level human disturbance potential nest sites	score
41	distance between active and potential nest sites	miles

Table C-3. YN Field Data Sheet - Estimate YN-HSI Values. **Plot:** _____
Shrub-Steppe, Grassland, Herb, Agriculture Serial: _____

Date: _____ **Start Time:** _____ **End Time:** _____ **Elapse:** _____

Observers: _____

Area: Satus (**S**), North. Satus (**NS**), Lower Satus (**LS**), Wanity Slough (**WS**), Toppenish Pump (**TP**), Wapato (**W**), South Lateral A (**SLA**), Mosebar (**M**)

Location in Area: _____

Conditions/Treatment: _____

Exotic Shrub Cover: 0%, 1-5%, 6-25%, 26-50%, 51-75%, >75%

Exotic Grass/Herb Cover: 0%, 1-5%, 6-25%, 26-50%, 51-75%, >75%

Cover Type: Forest Shrub **H**erb Herb/Forest Herb/Shrub Shrub/Steppe **Ag-f**allow

Ag-pasture **L**acustrine **R**iverine OpenWater(**POW**) AquaticBed(**PAB**) Water Lily (**PAB4**)

SGCM(SandGravelCobble) Cattail-Bulrush(emergent **PEM**) Palustrine Shrub(**PSS**) Other ___

Photo Roll: _____ **Exposures:** _____

Hydrology of Stream or Wetland: absent or highly degraded, function restored, natural or near natural

Stand Age: _____ (explain basis of estimate) _____

Sample Area: 1 acre circular plot = 118 foot radius *1/4 acre circular plot = 59 foot radius*

SAND GRAVEL MUD							
percent of area	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover organic debris	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
SHRUBS							
percent cover	none	Solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover deciduous	none	Solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover hydrophytic	none	Solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
Average height	0	< 1 ft	1-3 ft	3-6 ft	6-10 ft	> 10 ft	
HERBS & GRASS							
percent herb & grass	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
grass as percent of g+h	None	Solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover < 2 ft	None	Solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
Average height	0	< 1 ft	1-3 ft	3-6 ft	6-10 ft	> 10 ft	
TREES	1	2	3	4	5	6	7
mature trees present	No	Yes					
HUMAN DISTURBANCE	none	<500'	< ¼ mile	¼½ mile	> ½ mile	> 1 mile	> 5 miles

Table C-3. Continued.
Shrub, Shrub-Steppe, Grassland, Herb, Agriculture

Plot: _____
Serial: _____

California Quail **S, Ag, SS/G, G, H**							
Distance to escape cover ***escape cover = > 8 ft high***	0	< 100ft	101-180ft	181-300ft	301-500ft	501-874ft	> 875 ft
av diameter escape patches	None	0-10 ft	11-20 ft	> 20 ft			
Distance to escape patches	None	< 30 ft	31-90 ft	91-200 ft	201-300ft	> 300 ft	
Canada Goose **nests in riparian trees** **Agp, Agf, SSG, H**							
Quality of foraging habitat							
Mallard **Nest: H, G, S, SSG, Ag-pf**							
Distance to emergent plants	0	<1/4 mile	1/4 to 3/4 mile	>3/4 mile			
height of nesting cover ***providing both horizontal and vertical screen of nest***	None	1-15 in	16-24 in	25-48 in	> 48 in		
Percent cover nest habitat	None	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
ratio of lily pads, cattail, or bulrush to open water	None	<40:60	40:60-60:40	>60-40			
Western Meadowlark **SS/G, Agp, Agf**							
Distance to perch sites	No perches	Few	scattered	abundant			
Great Blue Heron ***Foraging: S, G, R, L, POW, PEM, PSS, Ag-pf***	1	2	3	4	5	6	7
Distance foraging to nest	0	<500'	<1/4 mile	¼ ½ mile	> ½ mile	> 1 mile	> 5 miles
Quality of foraging habitat	none	Dry ag-pf	Wet ag-pf	Shlw mrk	shlw clr	Dp mrk	Dp clr
potential nest sites	no	yes					
Mink **F, S, R, PEM, PSS**							
percent of year with water	0	1-25 %	26-50 %	51-75 %	100 %		
percent tree/shrub cover within 330 feet water edge	none	Solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent tree/shrub cover along shoreline	none	Solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %

Table C-4. YN Datasheet - Estimate YN-HSI Values. **Plot:** _____

Trees and Shrubs **Serial:** _____

Date: _____ **Start Time:** _____ **End Time:** _____ **Elapse:** _____

Observers: _____

Area: Satus (**S**), North. Satus (**NS**), Lower Satus (**LS**), Wanity Slough (**WS**), Toppenish Pump (**TP**), Wapato (**W**), South Lateral A (**SLA**), Mosebar (**M**)

Location in Area: _____

Conditions/Treatment: _____

Exotic Shrub Cover: 0%, 1-5%, 6-25%, 26-50%, 51-75%, >75%

Exotic Grass/Herb Cover: 0%, 1-5%, 6-25%, 26-50%, 51-75%, >75%

GIS Cover Type: Forest Shrub Herb Herb/Forest Herb/Shrub Shrub/Steppe Ag-fallow Ag-pasture **SGCM**(SandGravelCobble) Lacustrine Riverine OpenWater(**POW**) AquaticBed(**PAB**) Water Lily (**PAB4**) **PUB**(mud) Cattail-Bulrush(emergent **PEM**) Palustrine Shrub(**PSS**) Other ____

Aerial Photo: _____

GIS/GPS Coordinates: _____

Photo Roll: _____ **Exposures:** _____ **Reoccupied or New Site**

Hydrology of Stream or Wetland: absent or highly degraded, function restored, natural or near natural

Land Use: hunt & non-consumptive rec, hunt & YN gathering, close - YN gathering, closed

Stand Age: _____ (explain basis of estimate) _____

Sample Area: 1 acre circular plot = 118 foot radius *1/4 acre circular plot = 59 foot radius*

TREES	1	2	3	4	5	6	7
mature trees present	no	yes					
percent canopy	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
average height	0	< 10 ft	10-25 ft	26-50 ft	51-100 ft	> 100 ft	
average dbh	0	< 4 in	4-8 in	8-12 in	12-24 in	24-36	>36 in
maximum dbh	0	< 4 in	4-8 in	8-12 in	12-24 in	24-36	>36 in
snags 4-6 in per ac	0	1-5	6-10	11-20	>20		
snags >6 in per ac	0	1-5	6-10	11-20	>20		
SHRUBS							
percent cover	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover deciduous	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover hydrophytic	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
average height	0	< 1 ft	1-3 ft	3-6 ft	6-10 ft	> 10 ft	
HERBS & GRASS							
percent cover	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent herb & grass	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
grass as percent of g+h	None	0	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover < 2 ft	None	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
average height	0	< 1 ft	1-3 ft	3-6 ft	6-10 ft	> 10 ft	

Table C-4. Continued.
Trees and Shrubs

Plot: _____
Serial: _____

Mink **F, S, R, PEM, PSS**							
percent of year with water	0	1-25 %	26-50 %	51-75 %	100 %		
percent tree/shrub cover within 330 feet water edge	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent tree/shrub cover along shoreline	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
Great Blue Heron F, S, G, R, L, POW, B, PAB, PEM, PSS, Agf, Agp							
distance from foraging areas to nest	xxx						
quality of foraging habitat	none	wet pasture	shallow clear H_20				
level of human disturbance potential foraging areas		frequent < 330 ft	not frequent				
availability of nest sites trees >18 ft high, open canopy, <750 ft to water	none	present					
level of human disturbance potential nest sites	land water	< 1/4 mile < 500 ft	> 1/4 mile > 500 ft				
distance between active and potential nest sites	xxx	xxx					

Table C-5. YN Datasheet - Estimate YN-HSI Values. **Plot:** _____

Lacustrine - Riverine - POW - PAB - PAB4 - PEM **Serial:** _____

Sand/Gravel/Mud

page 1

Date: _____ **Start Time:** _____ **End Time:** _____ **Elapse:** _____

Observers: _____

Area: Satus (**S**), North. Satus (**NS**), Lower Satus (**LS**), Wanity Slough (**WS**), Toppenish Pump (**TP**), Wapato (**W**), South Lateral A (**SLA**), Mosebar (**M**)

Location in Area: _____

Conditions/Treatment: _____

Exotic Cover: 0%, 1-5%, 6-25%, 26-50%, 51-75%, >75% _____

GIS Cover Type: Forest Shrub Herb Herb/Forest Herb/Shrub Shrub/Steppe Ag-fallow Ag-pasture Lacustrine Riverine OpenWater(**POW**) AquaticBed(**PAB**) Water Lily (**PAB4**) B(SandGravelCobble) **PUB**(mud) Cattail-Bulrush(emergent **PEM**) Palustrine Shrub(**PSS**) Other ____

Aerial Photo: _____

GIS/GPS Coordinates: _____

Photo Roll: _____ **Exposures:** _____ **Reoccupied or New Site**

Hydrology of Stream or Wetland: absent or highly degraded, function restored, natural or near natural

Land Use: hunt & non-consumptive rec, hunt & YN gathering, close - YN gathering, closed

Stand Age: _____ (explain basis of estimate) _____

Sample Area: 1 acre circular plot = 118 foot radius *1/4 acre circular plot = 59 foot radius*

AQUATIC-RIVERINE							
percent cover floating	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cover sedge/rush	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
	1	2	3	4	5	6	7
Sand Gravel Mud							
percent of area	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent cov organic debris	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
Mallard Nesting: H, G, SG, S, SS Brood: L, POW, PAB, PEM							
distance from nest to emergent plants	> 3/4 mile	1/4 to 3/4 mile	< 1/4 mile				
height of residual cover	1/15 in	16-24 in	25-48 in	> 48 in			
percent cover nest habitat	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
level of human disturbance	none	low	Moderate	high			
ratio PEM to open water	<40:60	40:60-60:40	>60-40				

Table C-5. Continued.
Lacustrine - Riverine - POW - PAB - PAB4 - PEM
Sand/Gravel/Mud

Plot: _____
Serial: _____

Spotted Sandpiper **sand, gravel, cobble, mud**							
distance nest sites to water							
Mink **F, S, R, PEM, PSS**							
percent of year with water	0	1-25 %	26-50 %	51-75 %	100 %		
percent tree/shrub cover within 330 feet water edge	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
percent tree/shrub cover along shoreline	none	solitary	1-5 %	6-25 %	26-50 %	51-75 %	76-100 %
Great Blue Heron ***nesting: F*** ***foraging: S, G, R, L, POW, B, PAB, PEM, PSS, Ag***	1	2	3	4	5	6	7
distance from foraging areas to nest	xxx						
quality of foraging habitat	none	wet pasture	shallow clear H_20				
level of human disturbance potential foraging areas		frequent < 330 ft	not frequent				
availability of nest sites trees >18 ft high, open canopy, <750 ft to water	none	present					
level of human disturbance potential nest sites	land water	< 1/4 mile < 500 ft	> 1/4 mile > 500 ft				
Distance between active and potential nest sites	xxx	xxx					

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

	Values are the column checked on field datasheet.									
	saved as Tb-64-68.xls, sheet: Tb-66									
Serial Number	1	2	3	4	5	6	7	8	9	10
Plot Number	SLA-1	SLA-2	SLA-3	SLA-4	SLA-5	SLA-6	SLA-7	SLA-8	SLA-9	SLA-10
Date	8/9/99	8/9/99	8/9/99	8/9/99	8/9/99	8/9/99	8/9/99	8/9/999	8/9/99	8/9/99
Observers	all	all	all	all	RSF et al	RSF et al	RSF et al	RSF et al	TH,A,H	TH,A,H
Wildlife Area	S Lat A	S Lat A	S Lat A	S Lat A	S Lat A	S Lat A	S Lat A	S Lat A	S Lat A	S Lat A
1991 Cover Type	SSG	PEM	SSG	Ag	Ag	L	Ag	PEM	PEM	rF
1999 Cover Type	SSG	PEM	SSG	Ag	Ag	L	Ag	PEM	PEM	rF
RAI Cover Type	G	PEM	G	Ag-pf	Ag-pf	POW	Ag-pf	PEM	PEM	F
% Exotic Shrubs	1	1	1	1	1	1	1	1	1	7
% Exotic grass, herb, or rush	1	3	3	7	7	1	6	4	3	1
Elapse Time	10	4	5	6	x	4	4	10	4	8
Stand Age	3	2	1.5	x	2	2	2	2	2	4
trees, present/absent	1	1	1	1	1	1	1	1	1	2
trees, percent cover	1	1	1	1	1	1	1	1	1	4
trees, average dbh	1	1	1	1	1	1	1	1	1	4
trees, max dbh	1	1	1	1	1	1	1	1	1	7
trees, height	1	1	1	1	1	1	1	1	1	4
basal area	1	1	1	1	1	1	1	1	1	4
snags, 4-6"dbh/ac	1	1	1	1	1	1	1	1	1	4
snags, 7-9"dbh/ac	1	1	1	1	1	1	1	1	1	4
snags, >10"dbh/ac	1	1	1	1	1	1	1	1	1	3
shrubs, percent cover	1	1	1	1	1	1	1	1	1	4
shrubs, % deciduous cover	1	1	1	1	1	1	1	1	1	7
shrubs, % hydrophytic cover	1	1	1	1	1	1	1	1	1	7
shrubs, average height	1	1	1	1	1	1	1	1	1	5
grass-herb, percent cover	6	1	1	6	6	1	7	1	1	7
grass, percent cover	6	1	5	6	6	1	7	1	1	7
grass as % of herb & grass	6	1	6	3	3	1	7	1	1	7
~~ratio of grass to herb~~	6	1	1	1	1	1	1	1	1	1
herbs, average height	2	1	2	2	2	1	2	1	1	4
herbs, percent cover <2 ft	5	1	6	3	7	1	6	1	1	2
SGCM, % organic cover	1	1	1	1	1	1	1	1	1	1
PEM, percent cover	1	4	1	1	1	1	1	4	5	1
PAB4, percent cover	1	1	1	1	1	1	1	1	1	1
human disturbance, distance	3	2	3	3	3	5	4	3	6	5
quail, distance escape cover	1	1	1	1	1	1	1	1	1	1
quail, diameter escape patches	3	1	3	3	4	1	4	1	1	1
quail, distance between patches	1	1	1	1	2	1	2	1	1	1
goose, nesting habitat	1	1	1	1	1	1	1	1	1	1
goose, distance nest/forage	3	1	3	1	2	1	4	1	1	1
mallard, dist. nest/rearing	1	1	1	1	2	2	2	1	2	1
mallard, height residual cover	1	1	1	2	1	1	2	1	1	1
mallard, percent nest cover	6	1	3	3	1	1	3	1	1	1
mallard, ratio PEM to POW	1	1	1	1	1	1	1	2	1	1
mallard, water regime	1	3	1	1	1	2	1	3	3	6
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	1	1	1	1	1	1
mink, % year with water	1	4	1	1	1	5	1	5	5	5
mink, % tree/shrub cover 330ft	1	1	1	1	1	1	1	3	4	5
mink, % tree/shrub cover edge	1	1	1	1	1	1	1	3	4	5
meadowlark, dist. perches	1	1	2	2	2	1	2	1	1	1
heron, dist. nest/foraging	4	4	4	6	4	5	5	4	6	3
heron, forage quality	1	4	1	1	2	4	2	4	3	5
heron, potential nest sites	1	1	1	1	1	1	1	1	1	2
heron, distance potential nests	6	6	4	6	1	7	7	7	6	2

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	11	12	13	14	15	16	17	18	19	20
Plot Number	SLA-11	SLA-12	SLA-13	SLA-14	TP-1	TP-2	TP-3	TP-4	TP-5	TP-6
Date	8/9/99	8/9/99	8/9/99	8/9/99	8/10/99	8/10/99	8/10/99	8/10/99	8/10/99	8/10/99
Observers	TH,A,H	TH,A,H	TH,A,H	all	all	all	all	all	all	all
Wildlife Area	S Lat A	S Lat A	S Lat A	S Lat A	Top Pmp	Top Pmp	Top Pmp	Top Pmp	Top Pmp	Top Pmp
1991 Cover Type	R	PEM	PEM	SSG	Ag	R	Ag	PEM	rS	Ag
1999 Cover Type	R	PEM	PEM	SSG	Ag	R	Ag	PEM	rS	Ag
RAI Cover Type	R	PEM	PEM	G	Ag-pf	R	Ag-pf	PEM	S	Ag-pf
% Exotic Shrubs	6	1	1	1	1	1	1	1	4	1
% Exotic grass, herb, or rush	1	3	2	1	7	1	7	3	1	7
Elapse Time	4	23	x	5	5	4	x	4	x	x
Stand Age	4	3	3	3	x	x	3	3	5	3
trees, present/absent	1	1	1	1	1	1	1	1	1	1
trees, percent cover	1	1	1	1	1	1	1	1	1	1
trees, average dbh	1	1	1	1	1	1	1	1	1	1
trees, max dbh	1	1	1	1	1	1	1	1	1	1
trees, height	1	1	1	1	1	1	1	1	1	1
basal area	1	1	1	1	1	1	1	1	1	1
snags, 4-6"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, 7-9"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, >10"dbh/ac	1	1	1	1	1	1	1	1	1	1
shrubs, percent cover	1	1	1	1	1	1	1	1	6	4
shrubs, % deciduous cover	1	1	1	1	1	1	1	1	6	4
shrubs, % hydrophytic cover	1	1	1	1	1	1	1	1	6	1
shrubs, average height	1	1	1	1	1	1	1	1	6	6
grass-herb, percent cover	1	1	1	7	7	1	7	1	4	7
grass, percent cover	1	1	1	5	5	1	5	1	4	7
grass as % of herb & grass	1	1	1	5	5	1	5	1	7	7
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1	1	1
herbs, average height	1	1	1	2	3	1	3	1	4	3
herbs, percent cover <2 ft	1	1	1	7	6	1	4	1	1	4
SGCM, % organic cover	1	1	1	1	1	1	1	1	1	1
PEM, percent cover	3	6	5	1	1	1	1	5	1	1
PAB4, percent cover	2	3	1	1	1	1	1	1	1	1
human disturbance, distance	5	5	5	5	3	6	5	5	5	5
quail, distance escape cover	1	1	1	3	3	1	1	1	2	2
quail, diameter escape patches	1	1	1	4	2	1	1	1	4	4
quail, distance between patches	1	1	1	4	4	1	1	1	3	4
goose, nesting habitat	1	1	1	1	1	1	1	1	1	1
goose, distance nest/forage	1	1	1	3	2	1	2	2	6	2
mallard, dist. nest/rearing	2	2	2	2	3	2	2	2	2	3
mallard, height residual cover	1	1	1	2	3	1	4	1	5	3
mallard, percent nest cover	1	1	1	3	4	1	7	1	5	7
mallard, ratio PEM to POW	1	3	2	1	1	3	1	3	1	1
mallard, water regime	2	3	3	1	1	2	1	3	6	1
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	1	1	1	1	1	1
mink, % year with water	5	5	5	1	1	5	1	5	5	1
mink, % tree/shrub cover 330ft	4	5	3	1	1	4	1	4	7	1
mink, % tree/shrub cover edge	4	5	3	1	1	4	1	4	7	1
meadowlark, dist. perches	1	1	1	3	3	1	2	1	1	3
heron, dist. nest/foraging	6	7	5	5	5	6	5	6	1	6
heron, forage quality	4	5	4	2	2	4	2	5	1	2
heron, potential nest sites	1	1	1	1	1	1	1	1	1	1
heron, distance potential nests	6	7	3	5	5	6	5	6	5	6

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	21	22	23	24	25	26	27	28	29	30
Plot Number	TP-7	TP-8	S-1	S-2	S-2b	S-10	S-11	S-12	S-13	S-14
Date	8/10/99	8/10/99	8/11/99	8/11/99	8/11/99	8/11/99	8/11/99	8/11/99	8/11/99	8/11/99
Observers	all	all	RF, TH	RF, TH	RF, TH	RF, TH	RF, TH	TH, HStM	TH, HStM	TH, HStM
Wildlife Area	Top Pmp	Top Pmp	Satus	Satus	Satus	Satus	Satus	Satus	Satus	Satus
1991 Cover Type	SSG	rF	rF	rF	rF	rH	SGCM	Ag	PEM	rS
1999 Cover Type	SSG	rF	rF	rF	rF	rH	SGCM	Ag	PEM	rS
RAI Cover Type	SSG	F	F	F	F	H	SGCM	Ag-p	PAB4	S
% Exotic Shrubs	x	4	4	1	1	1	1	1	1	7
% Exotic grass, herb, or rush	x	7	5	4	2	4	1	7	6	7
Elapse Time	x	x	10	7	x	4	4	4	1	3
Stand Age	x	x	x	x	100	4	2	6	x	x
trees, present/absent	1	2	2	2	2	1	1	1	1	1
trees, percent cover	1	6	5	6	6	1	1	1	1	1
trees, average dbh	1	4	6	5	5	1	1	1	1	1
trees, max dbh	1	5	7	7	6	1	1	1	1	1
trees, height	1	5	5	5	5	1	1	1	1	1
basal area	1	4	4	4	4	1	1	1	1	1
snags, 4-6"dbh/ac	1	4	1	4	4	1	1	1	1	1
snags, 7-9"dbh/ac	1	4	1	4	4	1	1	1	1	1
snags, >10"dbh/ac	1	4	1	4	4	1	1	1	1	1
shrubs, percent cover	6	4	6	5	7	1	1	1	1	7
shrubs, % deciduous cover	6	4	6	5	7	1	1	1	1	7
shrubs, % hydrophytic cover	1	4	4	4	6	1	1	1	1	2
shrubs, average height	3	5	6	5	5	1	1	1	1	6
grass-herb, percent cover	5	6	5	7	4	7	1	7	1	7
grass, percent cover	5	6	4	7	4	7	1	7	1	6
grass as % of herb & grass	5	6	4	7	5	3	1	6	1	7
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1	1	1
herbs, average height	3	4	2	4	4	3	1	3	1	3
herbs, percent cover <2 ft	7	3	4	5	4	6	1	4	1	5
SGCM, % organic cover	1	1	1	1	1	1	7	1	1	1
PEM, percent cover	1	1	1	1	1	1	3	1	6	1
PAB4, percent cover	1	1	1	1	1	1	1	1	5	1
human disturbance, distance	3	5	5	5	5	5	5	5	5	5
quail, distance escape cover	2	1	1	1	1	2	1	2	1	1
quail, diameter escape patches	3	1	1	1	1	4	1	4	1	1
quail, distance between patches	3	1	1	1	1	4	1	1	1	1
goose, nesting habitat	1	1	2	1	1	1	1	1	1	1
goose, distance nest/forage	5	5	1	1	1	1	1	1	1	1
mallard, dist. nest/rearing	2	1	2	1	1	3	1	2	2	1
mallard, height residual cover	3	1	1	1	1	2	1	2	1	1
mallard, percent nest cover	4	1	5	1	1	4	1	5	1	1
mallard, ratio PEM to POW	1	1	1	1	1	1	1	1	4	1
mallard, water regime	1	6	6	6	6	5	5	1	3	6
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	1	1	2	1	1	1
mink, % year with water	1	1	2	5	5	1	1	1	5	4
mink, % tree/shrub cover 330ft	1	6	6	7	7	1	1	1	6	5
mink, % tree/shrub cover edge	1	6	6	7	7	1	1	1	6	5
meadowlark, dist. perches	4	1	1	1	1	1	1	4	1	1
heron, dist. nest/foraging	6	2	5	3	3	1	1	5	5	6
heron, forage quality	2	3	2	1	1	1	5	3	4	1
heron, potential nest sites	1	2	2	2	2	1	1	1	1	1
heron, distance potential nests	4	2	4	2	2	1	4	5	5	6

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	31	32	33	34	35	36	37	38	39	40
Plot Number	NS-1	NS-2	NS-11	NS-12	NS-13	NS-14	SS-1	SS-2	SS-3	SS-4
Date	8/12/99	8/12/99	8/12/99	8/12/99	8/12/99	8/12/99	8/12/99	8/12/99	8/12/99	8/12/99
Observers	RS, JSF	RF, JSF	RF, JSF	TH, Feen	TH, Feen	TH, Feen	TH RF JS	TH RF JS	TH RF JS	TH RF JS
Wildlife Area	N-Satus	N-Satus	N-Satus	N-Satus	N-Satus	N-Satus	S-Satus	S-Satus	S-Satus	S-Satus
1991 Cover Type	SSG	Ag	SSG	rF	SGCM	R	PEM	SSG	SSG	PEM
1999 Cover Type	SSG	Ag	SSG	rF	SGCM	R	PEM	SSG	SSG	PEM
RAI Cover Type	SSG	Ag-pf	SSG	F	SGCM	R	PEM	SSG	G	PAB4
% Exotic Shrubs	x	1	1	1	11	3	1	1	1	1
% Exotic grass, herb, or rush	3	6	6	7	3	1	2	1	6	3
Elapse Time	x	6	7	12	2	1	5	x	7	7
Stand Age	x	x	x	x	2	x	7	x	x	x
trees, present/absent	1	1	1	2	1	1	1	1	1	1
trees, percent cover	1	1	1	5	1	1	1	1	1	1
trees, average dbh	1	1	1	5	1	1	1	1	1	1
trees, max dbh	1	1	1	6	1	1	1	1	1	1
trees, height	1	1	1	5	1	1	1	1	1	1
basal area	1	1	1	4	1	1	1	1	1	1
snags, 4-6"dbh/ac	1	1	1	5	1	1	1	1	1	1
snags, 7-9"dbh/ac	1	1	1	5	1	1	1	1	1	1
snags, >10"dbh/ac	1	1	1	5	1	1	1	1	1	1
shrubs, percent cover	4	3	5	5	1	1	1	5	2	1
shrubs, % deciduous cover	1	1	1	5	1	1	1	1	2	1
shrubs, % hydrophytic cover	1	1	1	2	1	1	1	1	1	1
shrubs, average height	3	3	3	4	1	1	1	3	4	1
grass-herb, percent cover	4	7	4	6	3	1	1	5	7	1
grass, percent cover	4	7	4	6	1	1	1	5	7	1
grass as % of herb & grass	5	3	7	7	1	1	1	5	5	1
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1	1	1
herbs, average height	2	3	2	2	2	1	1	3	3	1
herbs, percent cover <2 ft	6	5	7	3	3	1	1	7	6	1
SGCM, % organic cover	1	1	1	1	3	1	1	1	1	1
PEM, percent cover	1	1	1	1	1	2	5	1	1	3
PAB4, percent cover	1	1	1	1	1	2	5	1	1	4
human disturbance, distance	5	5	5	5	5	5	5	5	4	5
quail, distance escape cover	4	5	5	1	1	1	1	2	5	1
quail, diameter escape patches	3	4	4	1	1	1	1	2	2	1
quail, distance between patches	5	5	6	1	1	1	1	2	6	1
goose, nesting habitat	1	1	1	3	1	1	1	1	1	1
goose, distance nest/forage	1	1	3	2	1	2	1	1	2	1
mallard, dist. nest/rearing	2	2	3	1	1	1	2	2	2	2
mallard, height residual cover	4	3	3	1	1	1	1	3	2	1
mallard, percent nest cover	3	4	4	1	1	1	1	4	3	1
mallard, ratio PEM to POW	1	1	1	1	1	1	3	1	1	2
mallard, water regime	1	1	1	6	5	2	3	1	1	3
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	2	1	1	1	1	1
mink, % year with water	1	1	1	3	1	5	5	1	1	5
mink, % tree/shrub cover 330ft	1	1	1	6	1	5	4	1	1	6
mink, % tree/shrub cover edge	1	1	1	6	1	5	4	1	1	6
meadowlark, dist. perches	4	3	3	1	1	1	1	3	2	1
heron, dist. nest/foraging	1	5	3	1	3	5	6	6	7	1
heron, forage quality	1	2	2	1	1	5	5	2	2	5
heron, potential nest sites	1	1	1	2	1	1	1	1	1	1
heron, distance potential nests	1	5	3	4	3	6	6	5	7	6

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	41	42	43	44	45	46	47	48	49	50
Plot Number	SS-5	SS-5	SS-6	WS-1	WS-2	WS-3	WS-4	WS-5	WS-6	M-1
Date	8/12/99	8/12/99	8/12/99	8/13/99	8/13/99	8/13/99	8/13/99	8/13/99	8/13/99	8/13/99
Observers	TH RS JS	TH RF JS	TH RF JS	TH RF LJ	TH RF LJ	TH RF LJ	TH RF LJ	TH RF LJ	TH RF LJ	TH RF LJ
Wildlife Area	S-Satus	S-Satus	S-Satus	Wanity	Wanity	Wanity	Wanity	Wanity	Wanity	Mosebar
1991 Cover Type	Ag	SGCM	R	Ag	Ag	Ag	R	rS	Ag	SGCM
1999 Cover Type	Ag	SGCM	R	Ag	Ag	Ag	R	rS	Ag	SGCM
RAI Cover Type	Ag-p	SGCM	R	Ag-p	Ag-p	Ag-pf	R	S	Ag-p	SGCM
% Exotic Shrubs	1	1	1	2	2	1	1	2	1	x
% Exotic grass, herb, or rush	7	1	4	2	2	2	2	2	2	x
Elapse Time	x	x	2	5	3	4	2	5	4	9
Stand Age	x	2	2	x	x	x	2	x	x	2
trees, present/absent	1	1	1	1	1	1	1	1	1	1
trees, percent cover	1	1	1	1	1	1	1	1	1	1
trees, average dbh	1	1	1	1	1	1	1	1	1	1
trees, max dbh	1	1	1	1	1	1	1	1	1	1
trees, height	1	1	1	1	1	1	1	1	1	1
basal area	1	1	1	1	1	1	1	1	1	1
snags, 4-6"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, 7-9"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, >10"dbh/ac	1	1	1	1	1	1	1	1	1	1
shrubs, percent cover	1	1	1	4	4	4	1	6	1	4
shrubs, % deciduous cover	1	1	1	1	1	4	1	6	1	1
shrubs, % hydrophytic cover	1	1	1	1	1	1	1	5	1	1
shrubs, average height	1	1	1	3	3	3	1	5	1	3
grass-herb, percent cover	7	1	1	6	6	7	1	4	7	5
grass, percent cover	7	1	1	6	6	7	1	4	7	5
grass as % of herb & grass	5	1	1	6	6	4	1	5	6	4
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1	1	1
herbs, average height	2	1	1	2	2	3	1	2	2	2
herbs, percent cover <2 ft	7	1	1	7	7	7	1	6	7	7
SGCM, % organic cover	1	1	3	1	1	1	1	1	1	1
PEM, percent cover	1	1	1	1	1	1	3	1	1	1
PAB4, percent cover	1	1	1	1	1	1	1	1	1	1
human disturbance, distance	5	6	5	5	5	5	5	5	5	5
quail, distance escape cover	3	1	1	5	5	2	1	2	2	3
quail, diameter escape patches	3	1	1	3	3	3	1	4	3	3
quail, distance between patches	4	1	1	6	6	4	1	3	3	4
goose, nesting habitat	1	1	1	1	1	1	1	1	1	1
goose, distance nest/forage	2	1	1	1	1	1	1	1	1	1
mallard, dist. nest/rearing	2	1	1	2	2	2	1	2	1	2
mallard, height residual cover	5	1	1	2	2	3	1	3	1	2
mallard, percent nest cover	3	1	1	2	2	4	1	4	1	4
mallard, ratio PEM to POW	1	1	1	1	1	1	1	1	1	1
mallard, water regime	1	5	2	1	1	1	2	6	1	5
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	2	1	1	1	1	1	1	1	1
mink, % year with water	1	1	5	1	1	1	5	5	1	1
mink, % tree/shrub cover 330ft	1	1	6	1	1	1	5	4	1	1
mink, % tree/shrub cover edge	1	1	6	1	1	1	5	5	1	1
meadowlark, dist. perches	3	1	1	2	2	3	1	2	2	2
heron, dist. nest/foraging	6	1	6	7	7	6	5	5	5	4
heron, forage quality	2	1	5	2	2	2	4	2	2	2
heron, potential nest sites	1	1	1	1	1	1	1	1	1	1
heron, distance potential nests	6	1	6	7	7	6	5	5	5	4

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	51	52	53	54	55	56	57	58	59	60
Plot Number	M-2	M-3	M-4	M-5	M-6	M-8	M-9	M-10	M-11	S3-1
Date	8/13/99	8/13/99	8/13/99	8/17/99	8/17/99	8/17/99	8/17/99	8/17/99	8/17/99	8/17/99
Observers	TH RF LJ	TH RF LJ	TH RF LJ	TH, RF	TH, RF	TH, RF	TH, RF	TH, RF	TH, RF	TH, RF
Wildlife Area	Mosebar	Mosebar	Mosebar	Mosebar	Mosebar	Mosebar	Mosebar	Mosebar	Mosebar	Satus
1991 Cover Type	PEM	Ag	L	Ag	Ag	rH	rS	Ag	L	rS
1999 Cover Type	PEM	Ag	L	Ag	Ag	rH	rS	Ag	L	rS
RAI Cover Type	PEM	Ag-pf	L	Ag-pf	Ag-c	H	S	Ag-pf	POW	S
% Exotic Shrubs	1	1	1	2	1	1	2	1	1	1
% Exotic grass, herb, or rush	2	7	2	7	7	1	4	7	2	3
Elapse Time	3	4	4	x	2	5	5	3	3	4
Stand Age	x	x	x	1	1	2	1	1	x	x
trees, present/absent	1	1	2	1	1	1	1	1	1	1
trees, percent cover	1	1	2	1	1	1	1	1	1	1
trees, average dbh	1	1	1	1	1	1	1	1	1	1
trees, max dbh	1	1	1	1	1	1	1	1	1	1
trees, height	1	1	1	1	1	1	1	1	1	1
basal area	1	1	1	1	1	1	1	1	1	1
snags, 4-6"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, 7-9"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, >10"dbh/ac	1	1	1		1	1	1	1	1	1
shrubs, percent cover	1	4	1	4	1	1	7	1	1	6
shrubs, % deciduous cover	1	4	1	4	1	1	7	1	1	6
shrubs, % hydrophytic cover	1	3	1	1	1	1	4	1	1	5
shrubs, average height	1	5	1	4	1	1	4	1	1	5
grass-herb, percent cover	1	6	1	7	7	5	4	7	1	4
grass, percent cover	1	6	1	7	7	5	4	7	1	4
grass as % of herb & grass	1	3	1	4	7	3	4	4	1	3
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1	1	1
herbs, average height	1	3	1	3	5	2	4	3	1	4
herbs, percent cover <2 ft	1	4	1	7	1	7	3	7	1	5
SGCM, % organic cover	1	1	1	1	1	1	1	1	1	1
PEM, percent cover	6	1	4	1	1	1	1	1	4	1
PAB4, percent cover	1	1	2	1	1	1	1	1	1	1
human disturbance, distance	4	4	5	5	5	5	5	5	5	5
quail, distance escape cover	1	2	1	4	6	3	2	5	1	2
quail, diameter escape patches	1	3	1	2	1	3	3	3	1	4
quail, distance between patches	1	4	1	3	1	2	2	4	1	2
goose, nesting habitat	1	1	1	1	1	1	1	1	1	1
goose, distance nest/forage	1	2	1	2	1	2	2	2	1	1
mallard, dist. nest/rearing	2	2	2	2	2	2	2	2	2	1
mallard, height residual cover	1	3	1	2	4	2	4	4	2	1
mallard, percent nest cover	1	7	1	4	1	1	7	5	1	1
mallard, ratio PEM to POW	3	1	2	1	1	1	1	1	2	1
mallard, water regime	3	1	2	1	1	5	6	1	2	6
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	1	1	1	1	1	1
mink, % year with water	5	1	1	1	1	1	5	1	1	1
mink, % tree/shrub cover 330ft	4	1	1	1	1	1	6	1	1	1
mink, % tree/shrub cover edge	4	1	1	1	1	1	5	1	1	1
meadowlark, dist. perches	1	2	1	3	3	1	1	2	1	1
heron, dist. nest/foraging	5	3	3	4	1	4	4	4	1	1
heron, forage quality	4	2	6	2	1	3	1	2	1	1
heron, potential nest sites	1	1	1	1	1	1	1	1	1	1
heron, distance potential nests	5	3	3	4	5	4	4	4	1	4

. Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	61	62	63	64	65	66	67	68	69	70
Plot Number	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	W-1	W-2	W-3	W-4
Date	8/17/99	8/17/99	8/17/99	8/17/99	8/17/99	8/17/99	8/18/99	8/18/99	8/18/99	8/18/99
Observers	TH, RF	TH, RF	TH, RF	TH, RF	TH, RF	TH, RF	TH et al	TH et al	TH et al	TH et al
Wildlife Area	Satus	Satus	Satus	Satus	Satus	Satus	Wapato	Wapato	Wapato	Wapato
1991 Cover Type	L	rH	PEM	PEM	SSG	L	SSG	rS	Ag	SSG
1999 Cover Type	L	rH	PEM	PEM	SSG	L	SSG	rS	Ag	SSG
RAI Cover Type	POW	H	PAB4	PAB4	G	L	G	S	Ag-cf	G
% Exotic Shrubs	1	1	1	1	1	1	1	1	1	1
% Exotic grass, herb, or rush	3	4	6	7	1	3	2	2	6	3
Elapse Time	3	5	3	4	3	3	5	5	8	5
Stand Age	x	x	x	x	2	1	7	7	3	20
trees, present/absent	1	1	1	1	1	1	1	1	1	1
trees, percent cover	1	1	1	1	1	1	1	1	1	1
trees, average dbh	1	1	1	1	1	1	1	1	1	1
trees, max dbh	1	1	1	1	1	1	1	1	1	1
trees, height	1	1	1	1	1	1	1	1	1	1
basal area	1	1	1	1	1	1	1	1	1	1
snags, 4-6"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, 7-9"dbh/ac	1	1	1	1	1	1	1	1	1	1
snags, >10"dbh/ac	1	1	1	1	1	1	1	1	1	1
shrubs, percent cover	1	1	1	1	1	1	1	7	1	5
shrubs, % deciduous cover	1	1	1	1	1	1	1	7	1	5
shrubs, % hydrophytic cover	1	1	1	1	1	1	1	6	1	4
shrubs, average height	1	1	1	1	1	1	1	3	1	5
grass-herb, percent cover	1	7	1	1	7	1	6	6	5	7
grass, percent cover	1	7	1	1	7	1	6	5	5	7
grass as % of herb & grass	1	5	1	1	6	1	6	5	7	7
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1	1	1
herbs, average height	1	2	1	1	3	1	2	3	3	4
herbs, percent cover <2 ft	1	7	1	1	3	1	7	1	5	5
SGCM, % organic cover	1	1	1	1	1	1	1	1	1	1
PEM, percent cover	3	1	4	4	1	3	1	1	1	1
PAB4, percent cover	5	1	5	7	1	3	1	1	1	1
human disturbance, distance	5	5	5	5	5	5	5	5	5	5
quail, distance escape cover	1	2	1	1	4	1	4	2	5	2
quail, diameter escape patches	1	3	1	1	3	1	3	4	4	4
quail, distance between patches	1	2	1	1	2	1	4	2	2	2
goose, nesting habitat	1	1	1	1	1	1	1	1	1	1
goose, distance nest/forage	1	2	1	1	2	2	2	2	2	2
mallard, dist. nest/rearing	2	2	2	2	2	2	2	2	2	2
mallard, height residual cover	1	2	1	1	4	1	2	5	3	4
mallard, percent nest cover	1	1	1	1	6	1	4	4	1	6
mallard, ratio PEM to POW	2	1	3	4	1	2	1	1	1	1
mallard, water regime	2	5	3	3	1	2	1	6	1	1
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	1	1	1	1	1	1
mink, % year with water	1	1	1	1	1	1	1	3	1	1
mink, % tree/shrub cover 330ft	1	1	1	1	1	1	1	7	1	1
mink, % tree/shrub cover edge	1	1	1	1	1	1	1	7	1	1
meadowlark, dist. perches	1	1	1	1	2	1	3	3	2	3
heron, dist. nest/foraging	1	4	4	4	4	4	3	3	2	2
heron, forage quality	1	3	4	4	3	7	2	1	2	2
heron, potential nest sites	1	1	1	1	1	1	1	1	1	1
heron, distance potential nests	1	4	4	4	4	4	3	3	2	2

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	71	72	73	74	75	76	77	78	79	80
Plot Number	W-5	W-6	W-7	W-8	W-9	LS-1	LS-2	LS-3	LS-4	LS-5
Date	8/18/99	8/18/99	8/18/99	8/18/99	8/18/99	8/19/99	8/19/99	8/19/99	8/19/99	8/19/99
Observers	TH et al	TH et al	TH et al	Thet al	TH et al	TH et al	TH et al	TH et al	TH et al	TH et al
Wildlife Area	Wapato	Wapato	Wapato	Wapato	Wapato	L-Satus	L-Satus	L-Satus	L-Satus	L-Satus
1991 Cover Type	rF	PEM	rF	SSG	R	R	rS	SGCM	SSG	Ag
1999 Cover Type	rF	PEM	rF	SSG	R	R	rS	SGCM	SSG	Ag
RAI Cover Type	F	PEM	F	SSG	R	R	S	SGCM	G	Ag-cf
% Exotic Shrubs	1	1	1	1	1	1	1	1	1	1
% Exotic grass, herb, or rush	1	4	1	4	1	1	2	1	2	7
Elapse Time	6	4	8	5	3	5	5	4	6	4
Stand Age	20	5	50	x	x	x	x	x	x	10
trees, present/absent	2	1	2	1	1	1	1	1	1	1
trees, percent cover	7	1	6	1	1	1	1	1	1	1
trees, average dbh	3	1	5	1	1	1	1	1	1	1
trees, max dbh	4	1	6	1	1	1	1	1	1	1
trees, height	4	1	6	1	1	1	1	1	1	1
basal area	4	1	4	1	1	1	1	1	1	1
snags, 4-6"dbh/ac	4	1	3	1	1	1	1	1	1	1
snags, 7-9"dbh/ac	4	1	2	1	1	1	1	1	1	1
snags, >10"dbh/ac	4	1	2	1	1	1	1	1	1	1
shrubs, percent cover	4	1	7	4	1	1	5	1	4	1
shrubs, % deciduous cover	4	1	7	3	1	1	5	1	4	1
shrubs, % hydrophytic cover	1	1	3	1	1	1	4	1	1	1
shrubs, average height	5	1	4	3	1	1	5	1	4	1
grass-herb, percent cover	3	1	5	6	1	1	4	1	7	6
grass, percent cover	3	1	4	6	1	1	5	1	7	6
grass as % of herb & grass	3	1	5	6	1	1	4	1	5	4
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1	1	1
herbs, average height	2	1	3	2	1	1	3	1	3	2
herbs, percent cover <2 ft	6	1	3	7	1	1	4	1	4	7
SGCM, % organic cover	12	1	1	1	1	1	1	3	1	1
PEM, percent cover	1	5	1	1	3	1	1	1	1	1
PAB4, percent cover	1	7	1	1	1	1	1	1	1	1
human disturbance, distance	5	4	5	5	5	5	5	5	5	4
quail, distance escape cover	1	1	1	2	1	1	1	1	2	5
quail, diameter escape patches	1	1	1	2	1	1	1	1	3	2
quail, distance between patches	1	1	1	3	1	1	1	1	3	6
goose, nesting habitat	1	1	2	1	1	1	1	1	1	1
goose, distance nest/forage	1	2	2	2	2	4	4	4	4	4
mallard, dist. nest/rearing	1	2	1	2	2	1	1	1	4	3
mallard, height residual cover	1	1	1	3	1	1	1	1	3	3
mallard, percent nest cover	1	1	1	3	1	1	1	1	6	1
mallard, ratio PEM to POW	1	3	1	1	2	1	1	1	1	1
mallard, water regime	6	3	6	1	2	2	6	5	1	1
sandpiper, % organic cover	1	1	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	1	1	1	2	1	1
mink, % year with water	3	3	3	1	5	5	5	1	1	1
mink, % tree/shrub cover 330ft	7	4	7	1	6	4	4	1	1	1
mink, % tree/shrub cover edge	7	4	7	1	6	5	5	1	1	1
meadowlark, dist. perches	1	1	1	3	1	1	1	1	3	3
heron, dist. nest/foraging	3	2	2	2	2	7	7	7	6	6
heron, forage quality	1	5	1	2	5	5	5	5	2	2
heron, potential nest sites	1	1	2	1	1	1	1	1	1	1
heron, distance potential nests	3	2	1	2	2	5	7	7	6	6

Table C-6. Yakama Method Field Estimates, Ordered by Plot Serial Number.

Serial Number	81	82	83	84	85	86	87	88
Plot Number	LS-6	LS-7	LS-8	LS-9	LS-10	LS-11	LS-12	LS-13
Date	8/19/99	8/19/99	8/19/99	8/19/99	8/19/99	8/19/99	8/19/99	8/19/99
Observers	TH et al	TH et al	TH et al	TH et al	TH et al	TH et al	TH et al	TH et al
Wildlife Area	L-Satus	L-Satus	L-Satus	L-Satus	L-Satus	L-Satus	L-Satus	L-Satus
1991 Cover Type	Ag	Ag	rF	rS	PEM	SSG	R	rH
1999 Cover Type	Ag	Ag	rF	rS	PEM	SSG	R	rH
RAI Cover Type	Ag-pf	Ag-pf	F	S	PEM	SSG	R	H
% Exotic Shrubs	1	1	21	7	1	1	1	1
% Exotic grass, herb, or rush	x	x	3	1	1	1	2	4
Elapse Time	4	5	6	6	4	5	4	2
Stand Age	x	10	50	x	x	10	x	x
trees, present/absent	1	1	2	1	1	1	1	1
trees, percent cover	1	1	7	1	1	1	1	1
trees, average dbh	1	1	4	1	1	1	1	1
trees, max dbh	1	1	5	1	1	1	1	1
trees, height	1	1	5	1	1	1	1	1
basal area	1	1	4	1	1	1	1	1
snags, 4-6"dbh/ac	1	1	5	1	1	1	1	1
snags, 7-9"dbh/ac	1	1	5	1	1	1	1	1
snags, >10"dbh/ac	1	1	5	1	1	1	1	1
shrubs, percent cover	2	3	3	7	1	5	1	1
shrubs, % deciduous cover	2	1	3	7	1	1	1	1
shrubs, % hydrophytic cover	1	1	3	1	1	1	1	1
shrubs, average height	4	3	4	6	1	4	1	1
grass-herb, percent cover	7	7	5	4	1	4	1	6
grass, percent cover	6	7	5	4	1	4	1	3
grass as % of herb & grass	4	6	5	3	1	7	1	4
~~ratio of grass to herb~~	1	1	1	1	1	1	1	1
herbs, average height	3	3	3	3	1	2	1	3
herbs, percent cover <2 ft	5	5	5	3	1	6	1	4
SGCM, % organic cover	1	1	1	1	1	1	1	1
PEM, percent cover	1	1	1	1	7	1	3	1
PAB4, percent cover	1	1	1	1	1	1	1	1
human disturbance, distance	4	5	3	5	5	4	3	3
quail, distance escape cover	4	6	1	2	1	6	1	2
quail, diameter escape patches	2	4	1	4	1	2	1	2
quail, distance between patches	5	6	1	2	1	2	1	2
goose, nesting habitat	1	1	1	1	1	1	1	1
goose, distance nest/forage	4	4	4	4	4	4	1	3
mallard, dist. nest/rearing	3	2	1	2	2	3	1	3
mallard, height residual cover	4	4	1	3	1	3	1	4
mallard, percent nest cover	5	5	1	3	1	4	1	6
mallard, ratio PEM to POW	1	1	1	1	4	1	1	1
mallard, water regime	1	1	6	6	3	1	2	5
sandpiper, % organic cover	1	1	1	1	1	1	1	1
sandpiper, distance nest/water	1	1	1	1	1	1	1	1
mink, % year with water	1	1	5	5	5	1	5	1
mink, % tree/shrub cover 330ft	1	1	6	6	6	1	4	1
mink, % tree/shrub cover edge	1	1	6	5	5	1	5	1
meadowlark, dist. perches	3	3	1	1	1	3	1	3
heron, dist. nest/foraging	6	7	6	5	5	7	7	7
heron, forage quality	2	2	1	2	4	2	5	1
heron, potential nest sites	1	1	1	1	1	1	1	1
heron, distance potential nests	6	7	6	5	5	7	7	7

Table C-7. Yakama Method Step Values-Attributes, Yakama Nation HEP Analysis.

		Datasheet Column						
Line	**parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4	trees, present/absent	absence	presence					
5	trees, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>76%
6	trees, height	0	<10'	11-25"	26-50'	51-100'	>100'	
7	trees, average dbh	0	<4"	4-8"	8-12"	13-24"	24-36"	>36"
8	trees, max dbh	0	<4"	4-8"	8-12"	13-24"	24-36"	>36"
9	basal area, sq. meters/hectare	0	5	10	15	20	30	40
10	snags, 4-6"dbh/ac	0	1	2	3	4	5	>5
11	snags, 7-9"dbh/ac	0	1	2	3	4	5	>5
12	snags, >10"dbh/ac	0	1	2	3	4	5	>5
13	shrubs, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
14	shrubs, % deciduous cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
15	shrubs, % hydrophytic cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
16	shrubs, average height	0	<1'	1-3'	3-6'	6-10'	>10'	
17	herb, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
18	grass, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
19	herb & grass, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
20	ratio of grass to herb							
21	herbs, average height	0	<1'	1-3'	3-6'	6-10'	>10'	
22	herbs, percent cover <2 ft	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
23	SGCM, % organic cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
24	PEM, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
25	PAB4, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
26	human disturbance, distance	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>5 miles
27	quail, distance to escape cover	0	<100'	101-200'	201-300'	301-500'	500-875'	>875'
28	quail, diameter escape patches	0	<10'	11-20'	>21'			
29	quail, distance between patches	0	<30'	31-90'	91-200'	201-300'	>300'	
30	goose, nesting habitat	0	few trees	abundant				
31	goose, distance nest/forage	0	<1 mile	1-2 m	> 2 miles			
32	mallard, distance nest/rearing	0	<1/4 mile	1/4-3/4	>3/4 mile			
33	mallard, height residual cover	0	<15"	16-24"	25-48"	>48"		
34	mallard, percent nest cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
35	mallard, ratio PEM to POW	0	<40:60	40:60	>40:60			
36	sandpiper, % organic cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
37	sandpiper, distance nest/water	0	0-10 '	11-20'	21-50'	51-100'	101-200'	>200'
38	mink, % year with water	0	1-25%	26-50%	51-75%	>75%		
39	mink, % tree/shrub cover 330ft	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
40	mink, % tree/shrub cover edge	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
41	meadowlark, distance perches	0	few	scattered	abundant			
42	heron, distance nest/foraging	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>2 miles
43	heron, forage quality	0	dry ag-p	wet ag-p	hlw mrk	shlw clr	dp mrky	dp clr
44	heron, potential nest sites	No	Yes					
45	heron, distance potential nests	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>2 miles
46	downy woodpecker	none						
47	black-capped chickadee	none						
48	yellow warbler	none						

Table C-7. Yakama Method Step Values-Attributes, Yakama Nation HEP Analysis.

		Datasheet Column						
Line	parameter	1	2	3	4	5	6	7
ariable	**California Quail**							
V1	grass and herbs, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V2	shrubs, average height	0	<1'	1-3'	3-6'	6-10'	>10'	0
V3	escape cover, distance to	0	<100'	101-200'	201-300'	301-500'	500-875'	>875'
V4	escape cover, patch diam/widt	0	<10'	11-20'	>21'	0	0	0
V5	escape cover, distance between	0	<30'	31-90'	91-200'	201-300'	>300'	0
	Canada goose							
V1	mature trees present	absence	presence	0	0	0	0	0
V3	nest to brood rearing, distance	0	<1 mile	1-2 m	> 2 miles	0	0	0
V4	human disturbance, distance	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>5 miles
	Mallard							
V3	herb/shrubs cover within 300 ft	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V4	herb/shrub cover 300-600 ft							
V5	nesting cover, height	0	<15"	16-24"	25-48"	>48"	0	0
V6	disturbance, human and dog	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>5 miles
V7	ratio PEM/PAB4 to POW	0	<40:60	40:60	>40:60	0	0	0
V-8	distance nesting/brood rearing	0	<1/4 mile	1/4-3/4	>3/4 mile	0	0	0
V-9	water regime	0	ermanen	intermit. exposed	emi-per	seasonal	emporar	intermit flooded
	Spotted Sandpiper							
V1	herbs <2', percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V2	nest to water, distance	<4"	4-8"	8-12"	13-24"	24-36"	>36"	#REF!
V3	organic debris, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
	Mink							
V1	surface water, precent of year	0	1-25%	26-50%	51-75%	>75%	0	0
V2	tree canopy, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>76%
V3	shrub canopy, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V4	PEM/PAB4, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V5	trees, percent cover within 330'	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V6	tree/shrub, % canopy shoreline	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
	Western Meadowlark							
V1	herbs & grass, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V2	grasses. percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V3	herb/grass, average height	0	<1'	1-3'	3-6'	6-10'	>10'	0
V4	perch sites, distance	0	few	scattered	abundant	0	0	0
V5	shrubs, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
	Black-capped Chickadee							
V1	trees, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>76%
V2	trees, average height	0	<10'	11-25"	26-50'	51-100'	>100'	0
V3	snags, #/ac 4-10" dbh	0	1	2	3	4	5	>5

Table C-7. Yakama Method Step Values-Attributes, Yakama Nation HEP Analysis.

Line	parameter	Datasheet Column 1	2	3	4	5	6	7
	Yellow Warbler							
V1	decid. shrubs, percent cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
V2	decid. shrubs, average height	0	<1'	1-3'	3-6'	6-10'	>10'	0
V3	hydrophytic shrubs, % cover	0	solitary	1-5%	6-25%	26-50%	51-75%	>75
	Great Blue Heron							
V1	nesting to feeding, distance	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>2 miles
V2	forage quality	0	dry ag-p	wet ag-p	hlw mrk	shlw clr	dp mrky	dp clr
V3	human disturbance	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>5 miles
V4	nest sites, availability	No	Yes	0	0	0	0	0
V5	disturbance at potential nest sit	0	<500'	<1/4 mile	1/4 -1/2	>1/2	>1 mile	>5 miles
V6	actual/potential nests, distance							

Table 64, continued

Line	parameter	Datasheet Column 1	2	3	4	5	6	7
	Downy Woodpecker							
V1	basal area, sq. meters/hectare	0	5	10	15	20	30	40
V2	snags, 7-9"dbh/ac	0	1	2	3	4	5	>5

Table C-8. Yakama Method Step Values for Species Models, Yakama Nation HEP Analysis.

Datasheet column score (Table C-7) converted to HSI variable values

Variable	line		datasheet column 1	2	3	4	5	6	7
		California Quail							
V1	29	grass and herbs, percent cover	0	0	0.1	0.3	0.6	1	0.9
V2	28	shrubs, average height	0	0.1	0.4	0.5	0.8	1	
V3	39	escape cover, distance to	1	1	0.8	0.5	0.3	0.1	0
V4	40	escape cover, patch diam/width	0	0.3	1	0.5	0	0	0
V5	41	escape cover, distance between	0.3	0.4	0.75	1	0.6	0.1	0
		Canada goose							
V1	16	mature trees present	0	1					
V3	42	nest to brood rearing, distance	1	1	0.5	0.2			
V4	43	human disturbance, distance	0	0	0.1	0.5	1	1	1
		Mallard							
V3	46	herb/shrubs cover within 300 ft	0	0.05	0.1	0.2	0.5	0.8	1
V4	46	herb/shrub cover 300-600 ft	0	0.05	0.1	0.2	0.5	0.8	1
V5	45	nesting cover, height	0	0.3	1	0.4	0.1	0	0
V6	38	disturbance, human and dog	0	0.1	0.2	0.5	1	1	1
V7	47	ratio PEM/PAB4 to POW	0	0.5	1	1	1	0.5	0
V-8	44	distance nesting/brood rearing	1	1	0.5	0.1	0	0	0
V-9	48	water regime	0	0.5	0.9	1.0	0.3	0	0
		Spotted Sandpiper							
V1	34	herbs <2', percent cover	0	0.1	0.2	0.7	1	0.5	0
V2	50	nest to water, distance	1	1	1	0.8	0.4	0	0
V3	49	organic debris, percent cover	1	1	1	1	1	0.7	0.3
		Mink							
V1	51	surface water, precent of year	0	0	0.5	0.75	1		
V2	17	tree canopy, percent cover	0.1	0.1	0.15	0.2	0.5	0.75	1
V3	25	shrub canopy, percent cover	0.1	0.1	0.15	0.2	0.5	0.75	1
V4	36	PEM/PAB4, percent cover	0	0.1	0.15	0.25	0.75	1	0.9
V5	52	trees, percent cover within 330'	0.1	0.1	0.2	0.3	0.4	0.5	1
V6	53	tree/shrub, % canopy shoreline	0	0	0.1	0.2	0.3	0.5	0.9
		Western Meadowlark							
V1	29	herbs & grass, percent cover	0	0	0.05	0.1	0.3	0.7	1
V2	30	grasses. percent cover	0	0	0.1	0.2	0.3	0.7	1
V3	33	herb/grass, average height	0	1	0.3	0	0	0	0
V4	54	perch sites, distance	0	0.25	0.75	1	0	0	0
V5	25	shrubs, percent cover	1	1	1	0.7	0.2	0	0
		Black-capped Chickadee							
V1	17	trees, percent cover	0	0.1	0.2	0.3	0.7	1	0.7
V2	20	trees, average height	0	0.1	0.2	0.7	1	1	
V3	23	snags, #/ac 4-10" dbh	0	0.5	1	1	1	1	1

Table C-8. Yakama Method Step Values for Species Models, Yakama Nation HEP Analysis.

Variable	line		datasheet column 1	2	3	4	5	6	7
		Yellow Warbler							
V1	26	decid. shrubs, percent cover	0	0	0.1	0.2	0.5	1	0.7
V2	28	decid. shrubs, average height	0	0	0.25	0.5	1	1	
V3	27	hydrophytic shrubs, % cover	0.1	0.15	0.2	0.25	0.4	0.6	0.9
		Great Blue Heron							
V1	55	nesting to feeding, distance	1	1	1	1	1	1	1
V2	56	forage quality	0.1	0.3	0.5	0.7	1	0.2	0.4
V3	38	human disturbance	0	0.1	0.3	0.5	1	1	1
V4	57	nest sites, availability	0	1	1	1	1	0.7	0.5
V5	58	disturbance at potential nest sites	0	0.5	1	1	1	1	1
V6	58	actual/potential nests, distance	1	1	1	1	1	1	1
		Downy Woodpecker							
V1	21	tree basal area	0	0.25	0.5	1	1	0.5	0
V2	23	number of sngs > 6" per acre	0	0.2	0.4	0.8	1	1	1

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	55	69	80	28	41	44	45	49	4
RAI Cover Type	Ag-c	Ag-cf	Ag-cf	Ag-p	Ag-p	Ag-p	Ag-p	Ag-p	Ag-pf
California Quail									
V1	0.90	0.60	1.00	0.90	0.90	1.00	1.00	0.90	1.00
V2	0.00	0.00	0.00	0.00	0.00	0.40	0.40	0.00	0.00
V3	0.10	0.30	0.30	1.00	0.80	0.30	0.30	1.00	1.00
V4	0.00	0.50	0.30	0.50	1.00	1.00	1.00	1.00	1.00
V5	0.30	0.40	0.10	0.30	1.00	0.10	0.10	0.75	0.30
HSI		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Plots > 1.0			XX	XX	XX	XX	XX	XX	XX
Canada Goose									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.10	1.00	0.00	0.10	0.00	0.00	0.00	0.00
HSI				0.71	0.74	0.71	0.71	0.71	0.71
Mallard									
V3	0.00	0.00	0.00	0.50	0.10	0.05	0.05	0.00	0.10
V4	0.00	0.00	0.00	0.50	0.10	0.05	0.05	0.00	0.10
V5	1.00	0.30	1.00	0.40	1.00	0.30	0.30	0.30	0.30
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50
V7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V-8	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00
V-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HSI			0.00	0.45	0.32	0.12	0.12	0.00	0.09
Spotted Sandpiper									
V1	0.00	1.00	0.00	0.70	0.00	0.00	0.00	0.00	0.20
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.10	0.10	0.10	0.10	0.10	0.20	0.20	0.10	0.10
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	55	69	80	28	41	44	45	49	4
RAI Cover Type	Ag-c	Ag-cf	Ag-cf	Ag-p	Ag-p	Ag-p	Ag-p	Ag-p	Ag-pf
Meadowlark									
V1	1.00	0.30	0.70	1.00	1.00	0.70	0.70	1.00	0.70
V2	1.00	0.30	0.70	1.00	1.00	0.70	0.70	1.00	0.70
V3	0.00	0.30	1.00	0.30	1.00	1.00	1.00	1.00	1.00
V4	0.75	0.25	0.75	1.00	0.75	0.25	0.25	0.25	0.25
V5	1.00	1.00	1.00	1.00	1.00	0.70	0.70	1.00	1.00
HSI				0.55	0.87	0.25	0.25	0.50	0.35
Chickadee									
V1									
V2									
V3									
HSI									
Yellow Warbler									
V1									
V2									
V3									
HSI									
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	0.10	0.30	0.30	0.50	0.30	0.30	0.30	0.30	0.10
V3	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	0.30
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI				0.50	0.30	0.30	0.30	0.30	0.03
Downy Woodpecker									
V1									
V2									
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	5	7	15	17	20	32	46	52	54
RAI Cover Type	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf
California Quail									
V1	1.00	0.90	0.90	0.90	0.90	0.90	0.90	1.00	0.90
V2	0.00	0.00	0.00	0.00	1.00	0.40	0.40	0.80	0.50
V3	1.00	1.00	0.80	1.00	1.00	0.30	1.00	1.00	0.50
V4	0.50	0.50	0.30	0.00	0.50	0.50	1.00	1.00	0.30
V5	0.40	0.40	1.00	0.30	1.00	0.60	1.00	1.00	0.75
HSI	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00
Plots > 1.0	XX	XX	XX		XX	XX	XX	XX	XX
Canada Goose									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.10	1.00	0.10	0.10	0.10	0.00	0.00	0.10	0.10
HSI	0.74	1.00	0.74	0.74	0.74	0.71	0.71	0.74	0.74
Mallard									
V3	0.00	0.10	0.20	1.00	1.00	0.20	0.20	1.00	0.20
V4	0.00	0.10	0.20	1.00	1.00	0.20	0.20	1.00	0.20
V5	0.30	0.30	1.00	0.30	1.00	1.00	1.00	0.30	1.00
V6	0.50	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00
V7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V-8	1.00	1.00	0.50	1.00	0.50	1.00	1.00	1.00	1.00
V-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HSI	0.00	0.17	0.22	0.55	1.00	0.45	0.45	0.55	0.45
Spotted Sandpiper									
V1	0.00	0.50	0.50	0.70	0.70	1.00	0.00	0.70	0.00
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.10	0.10	0.10	0.10	0.20	0.15	0.20	0.20	0.20
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	5	7	15	17	20	32	46	52	54
RAI Cover Type	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf	Ag-pf
Meadowlark									
V1	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.70	1.00
V2	0.70	1.00	0.30	0.30	1.00	1.00	1.00	0.70	1.00
V3	1.00	1.00	0.30	0.30	0.30	0.30	0.30	0.30	0.30
V4	0.25	0.25	0.75	0.25	0.75	0.75	0.75	0.25	0.75
V5	1.00	1.00	1.00	1.00	0.70	1.00	0.70	0.70	0.70
HSI	0.35	0.50	0.26	0.15	0.33	0.47	0.33	0.13	0.33
Chickadee									
V1									
V2									
V3									
HSI									
Yellow Warbler									
V1									
V2									
V3									
HSI									
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
V3	0.30	0.50	0.30	1.00	1.00	1.00	1.00	0.50	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	0.09	0.15	0.09	0.30	0.30	0.30	0.30	0.15	0.30
Downy Woodpecke									
V1									
V2									
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	58	81	82	10	22	23	24	25	34
RAI Cover Type	Ag-pf	Ag-pf	Ag-pf	F	F	F	F	F	F
California Quail									
V1	0.90	0.90	0.90	0.90	1.00	0.60	0.90	0.30	1.00
V2	0.00	0.50	0.40	0.80	0.80	1.00	0.80	0.80	0.50
V3	0.30	0.50	0.10	1.00	1.00	1.00	1.00	1.00	1.00
V4	1.00	0.30	0.50	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	0.60	0.10	0.30	0.30	0.30	0.30	0.30	0.30
HSI	1.00	1.00	1.00						
Plots > 1.0	XX	XX	XX						
Canada Goose									
V1	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50
V4	0.10	1.00	1.00	0.00	1.00	0.00	0.00	0.00	0.10
HSI	0.74	1.00	1.00	0.71	1.00	0.71	0.71	0.71	0.55
Mallard									
V3	0.50	0.50	0.50	0.00	0.00	0.50	0.00	0.00	0.00
V4	0.50	0.50	0.50	0.00	0.00	0.50	0.00	0.00	0.00
V5	0.30	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V-8	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HSI	0.39	0.71	0.71						
Spotted Sandpiper									
V1	0.00	1.00	1.00	0.10	0.20	0.70	1.00	0.70	0.20
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	0.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.50
V2	0.10	0.10	0.10	0.20	0.75	0.50	0.75	0.75	0.50
V3	0.10	0.10	0.15	0.20	0.20	0.75	0.50	1.00	0.50
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.10	0.10	0.10	0.40	0.50	0.50	1.00	1.00	0.50
V6	0.00	0.00	0.00	0.30	0.70	0.70	1.00	1.00	0.70
HSI				0.40	0.73	0.88	1.00	1.00	0.75

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	58	81	82	10	22	23	24	25	34
RAI Cover Type	Ag-pf	Ag-pf	Ag-pf	F	F	F	F	F	F
Meadowlark									
V1	1.00	1.00	1.00	1.00	0.70	0.30	1.00	0.10	0.70
V2	1.00	0.70	1.00	1.00	0.70	0.20	1.00	0.20	0.70
V3	0.30	0.30	0.30	0.00	0.00	1.00	0.00	0.00	1.00
V4	0.25	0.75	0.75	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	1.00	0.70	0.70	0.00	0.20	0.00	0.20
HSI	0.27	0.40	0.47						
Chickadee									
V1				0.30	1.00	0.70	1.00	1.00	0.70
V2				0.70	1.00	1.00	1.00	1.00	1.00
V3				1.00	1.00	0.00	1.00	1.00	1.00
HSI				0.59	1.00	0.00	1.00	1.00	0.89
Yellow Warbler									
V1									
V2									
V3									
HSI									
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	0.30	0.30	0.30	1.00	0.50	0.30	0.10	0.10	0.10
V3	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
V5	1.00	1.00	1.00	0.50	0.00	1.00	0.00	0.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	0.30	0.15	0.30	0.71	0.00	0.55	0.00	0.00	0.32
Downy Woodpecke									
V1				1.00	1.00	1.00	1.00	1.00	1.00
V2				0.80	0.80	0.00	0.80	0.80	1.00
HSI				0.80	0.80	0.00	0.80	0.80	1.00

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	71	73	83	1	3	14	39	65	67
RAI Cover Type	F	F	F	G	G	G	G	G	G
California Quail									
V1	0.10	0.60	0.60	1.00	0.00	0.90	0.90	0.90	1.00
V2	0.80	0.50	0.50	0.00	0.00	0.00	0.50	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	0.80	0.30	0.50	0.50
V4	0.00	0.00	0.00	1.00	1.00	0.50	0.30	1.00	1.00
V5	0.30	0.30	0.30	0.30	0.30	1.00	0.10	0.40	1.00
HSI				1.00	0.67	1.00	1.00	1.00	1.00
Plots > 1.0				XX		XX	XX	XX	XX
Canada Goose									
V1	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.10	1.00	0.50	0.50	0.50	0.10	0.10	0.10
HSI	0.71	0.74	1.00	0.87	0.87	0.87	0.74	0.74	0.74
Mallard									
V3	0.00	0.00	0.00	0.80	0.10	0.10	0.10	0.80	0.20
V4	0.00	0.00	0.00	0.80	0.10	0.10	0.10	0.80	0.20
V5	0.00	0.00	0.00	0.00	0.30	1.00	0.30	0.30	1.00
V6	1.00	1.00	0.50	0.50	0.50	1.00	1.00	1.00	1.00
V7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V-8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HSI				0.00	0.09	0.32	0.17	0.49	0.45
Spotted Sandpiper									
V1	0.50	0.20	1.00	1.00	0.50	0.00	0.50	0.20	0.00
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	0.50	0.50	1.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	1.00	0.75	1.00	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.20	1.00	0.15	0.10	0.10	0.10	0.10	0.10	0.10
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	0.50	0.10	0.10	0.10	0.10	0.10	0.10
V6	1.00	1.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00
HSI	1.00	1.10	0.83						

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	71	73	83	1	3	14	39	65	67
RAI Cover Type	F	F	F	G	G	G	G	G	G
	XX	XX							
Meadowlark									
V1	0.05	0.30	0.30	0.70	0.00	1.00	1.00	1.00	0.70
V2	0.10	0.20	0.30	0.70	0.30	0.30	1.00	1.00	0.70
V3	1.00	0.30	0.30	1.00	1.00	1.00	0.30	0.30	1.00
V4	0.00	0.00	0.00	0.00	0.25	0.75	0.25	0.25	0.75
V5	0.70	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI				0.00	0.00	0.47	0.27	0.27	0.61
Chickadee									
V1	0.70	1.00	0.70						
V2	0.70	1.00	1.00						
V3	1.00	0.50	1.00						
HSI	0.79	0.79	0.89						
Yellow Warbler									
V1				0.00					
V2				0.00					
V3				0.10					
HSI				0.00					
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	0.10	0.10	0.10	0.10	0.10	0.30	0.30	0.50	0.30
V3	1.00	1.00	0.30	0.30	0.30	1.00	0.50	1.00	1.00
V4	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	0.00	0.10	0.00	0.03	0.03	0.30	0.15	0.50	0.30
Downy Woodpecke									
V1	1.00	1.00	1.00						
V2	0.80	0.20	1.00						
HSI	0.80	0.20	1.00						

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	70	79	26	56	62	88	53	66	29
RAI Cover Type	G	G	H	H	H	H	L	L	PAB4
California Quail									
V1	0.90	0.90	0.90	0.60	0.90	1.00	0.00	0.00	0.00
V2	0.80	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00
V4	0.50	1.00	0.50	1.00	1.00	0.30	0.00	0.00	0.00
V5	0.40	0.75	1.00	0.40	0.40	0.40	0.30	0.30	0.30
HSI	1.00	1.00	1.00	1.00	1.00	1.00			
Plots > 1.0	XX	XX	XX	XX	XX	XX			
Canada Goose									
V1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.10	1.00	0.00	0.10	0.10	0.50	0.00	0.10	0.00
HSI	0.74	1.00	0.71	0.74	0.74	0.87	0.71	0.74	
Mallard									
V3	0.80	0.80	0.20	0.00	0.00	0.80	0.00	0.00	0.00
V4	0.80	0.80	0.20	0.00	0.00	0.80	0.00	0.00	0.00
V5	1.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
V6	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00	1.00
V7	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	1.00
V-8	1.00	0.10	0.50	1.00	1.00	0.50	1.00	1.00	1.00
V-9	0.00	0.00	0.30	0.30	0.30	0.30	0.50	0.50	0.90
HSI	0.89	0.89	0.00	0.00	0.00	0.45	0.25	0.25	0.90
Spotted Sandpiper									
V1	1.00	0.70	0.50	0.00	0.00	0.70	0.00	0.00	0.00
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.50	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.15	1.00
V5	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.50
V6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70
HSI									0.90

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	70	79	26	56	62	88	53	66	29
RAI Cover Type	G	G	H	H	H	H	L	L	PAB4
Meadowlark									
V1	1.00	1.00	1.00	0.30	1.00	0.70	0.00	0.00	0.00
V2	1.00	1.00	1.00	0.30	1.00	0.10	0.00	0.00	0.00
V3	0.00	0.30	0.30	1.00	1.00	0.30	0.00	0.00	0.00
V4	0.75	0.75	0.00	0.00	0.00	0.75	0.00	0.00	0.00
V5	0.20	0.70	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	0.00	0.33							
Chickadee									
V1									
V2									
V3									
HSI									
Yellow Warbler									
V1									
V2									
V3									
HSI									
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	0.30	0.30	0.10	0.50	0.50	0.10	0.20	0.40	0.70
V3	1.00	1.00	1.00	1.00	1.00	0.30	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.50	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	0.30	0.30					0.20	0.40	
Downy Woodpecke									
V1									
V2									
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	40	63	64	2	8	9	12	13	18
RAI Cover Type	PAB4	PAB4	PAB4	PEM	PEM	PEM	PEM	PEM	PEM
California Quail									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
HSI									
Plots > 1.0									
Canada Goose									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
HSI									
Mallard									
V3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V6	1.00	1.00	1.00	0.10	0.50	1.00	1.00	1.00	1.00
V7	0.50	1.00	1.00	0.00	0.50	0.00	1.00	0.50	1.00
V-8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V-9	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
HSI	0.45	0.90	0.90	0.00	0.45	0.00	0.90	0.45	0.90
Spotted Sandpiper									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	1.00	0.00	0.00	0.75	1.00	1.00	1.00	1.00	1.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V4	0.15	0.25	0.25	0.25	0.25	0.75	1.00	0.75	0.75
V5	0.50	0.10	0.10	0.10	0.20	0.30	0.40	0.20	0.30
V6	0.70	0.00	0.00	0.00	0.10	0.20	0.30	0.10	0.20
HSI	0.22	0.22	0.22	0.22	0.24	0.66	0.88	0.64	0.66

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	40	63	64	2	8	9	12	13	18
RAI Cover Type	PAB4	PAB4	PAB4	PEM	PEM	PEM	PEM	PEM	PEM
Meadowlark									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									0.00
Chickadee									
V1									
V2									
V3									
HSI									
Yellow Warbler									
V1									
V2									
V3									
HSI									
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	1.00	0.70	0.70	0.70	0.70	0.50	1.00	0.70	1.00
V3	1.00	1.00	1.00	0.10	0.30	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Downy Woodpecke									
V1									
V2									
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	37	51	72	85	6	59	61	11	16
RAI Cover Type	PEM	PEM	PEM	PEM	POW	POW	POW	R	R
California Quail									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
HSI									
Plots > 1.0									
Canada Goose									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.10	1.00	0.00	0.00	0.00	0.00	0.00
HSI					0.71	0.71	0.71		
Mallard									
V3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V7	1.00	1.00	1.00	1.00	0.00	0.50	0.50	0.00	1.00
V-8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V-9	0.90	0.90	0.90	0.90	0.50	0.50	0.50	0.50	0.50
HSI	0.90	0.90	0.90	0.90	0.00	0.25	0.25		
Spotted Sandpiper									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	1.00	1.00	0.50	1.00	1.00	0.00	0.00	1.00	1.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V4	0.75	1.00	0.75	0.90	0.00	0.25	0.15	0.15	0.00
V5	0.30	0.30	0.30	0.50	0.10	0.10	0.10	0.30	0.30
V6	0.20	0.20	0.20	0.30	0.00	0.00	0.00	0.20	0.20
HSI	0.66	0.86	0.66	0.82				0.24	0.24

.Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	37	51	72	85	6	59	61	11	16
RAI Cover Type	PEM	PEM	PEM	PEM	POW	POW	POW	R	R
Meadowlark									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Chickadee									
V1									
V2									
V3									
HSI									
Yellow Warbler									
V1									
V2									
V3									
HSI									
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	1.00	0.70	1.00	0.70	0.70	0.10	0.10	0.70	0.70
V3	1.00	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	0.50	1.00	1.00	0.00	0.00	1.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI					0.70	0.10	0.10	0.70	0.70
Downy Woodpecke									
V1									
V2									
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	36	43	47	75	76	87	19	30	48
RAI Cover Type	R	R	R	R	R	R	S	S	S
California Quail									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.90	0.30
V2	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.80
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
V5	0.30	0.30	0.30	0.30	0.30	0.30	0.75	0.30	0.75
HSI							1.00	1.00	1.00
Plots > 1.0							XX	XX	XX
Canada Goose									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.10	0.00	0.00	0.10	1.00	0.00	1.00	0.00	0.00
HSI									
Mallard									
V3	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.20
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.20
V5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30
V6	1.00	1.00	1.00	1.00	1.00	0.50	1.00	1.00	1.00
V7	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00
V-8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V-9	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00
HSI									
Spotted Sandpiper									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.50
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI									
Mink									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.10	0.10	0.10	0.10	0.10	0.10	0.75	1.00	0.75
V4	0.10	0.00	0.15	0.15	0.00	0.15	0.00	0.00	0.00
V5	0.40	0.50	0.40	0.50	0.30	0.30	1.00	0.40	0.30
V6	0.30	0.70	0.30	0.70	0.30	0.30	1.00	0.30	0.30
HSI	0.35	0.59	0.35	0.59	0.30	0.30	0.93	0.75	0.58

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	36	43	47	75	76	87	19	30	48
RAI Cover Type	R	R	R	R	R	R	S	S	S
Meadowlark									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.00	0.10
V2	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.70	0.20
V3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
V5	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00
HSI									
Chickadee									
V1									
V2									
V3									
HSI									
Yellow Warbler									
V1							1.00	0.70	1.00
V2							1.00	1.00	1.00
V3							0.60	0.15	0.40
HSI							0.84	0.47	0.74
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	1.00	1.00	0.70	1.00	1.00	1.00	0.10	0.10	0.30
V3	1.00	1.00	1.00	1.00	1.00	0.30	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	1.00	1.00	0.70	1.00	1.00	0.30			
Downy Woodpecke									
V1									
V2									
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	57	60	68	77	84	27	35	42	50
RAI Cover Type	S	S	S	S	S	SGCM	SGCM	SGCM	SGCM
California Quail									
V1	0.30	0.30	1.00	0.30	0.30	0.00	0.10	0.00	0.60
V2	0.50	0.80	0.40	0.80	1.00	0.00	0.00	0.00	0.40
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80
V4	1.00	0.50	0.50	0.00	0.50	0.00	0.00	0.00	1.00
V5	0.40	0.40	0.40	0.30	0.40	0.30	0.30	0.30	1.00
HSI	1.00	1.00	1.00	1.00	1.00				
Plots > 1.0	XX	XX	XX	XX	XX				
Canada Goose									
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.10	0.00	0.10	1.00	1.00	0.00	0.00	0.00	0.00
HSI						0.71	0.71	0.71	0.71
Mallard									
V3	1.00	0.00	0.20	0.00	0.10	0.00	0.00	0.00	0.20
V4	1.00	0.00	0.20	0.00	0.10	0.00	0.00	0.00	0.20
V5	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.30
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V-8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V-9	0.00	0.00	0.00	0.00	0.00	0.30	0.30	0.30	0.30
HSI						0.00	0.00	0.00	0.24
Spotted Sandpiper									
V1	0.20	1.00	0.00	0.70	0.20	0.00	0.20	0.00	0.00
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI						0.67	0.73	0.67	0.67
Mink									
V1	1.00	0.00	0.50	1.00	1.00	0.00	0.00	0.00	0.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	1.00	0.75	1.00	0.50	1.00	0.10	0.10	0.10	0.20
V4	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00
V5	0.50	0.10	1.00	0.30	0.50	0.10	0.10	0.10	0.10
V6	0.30	0.00	1.00	0.30	0.30	0.00	0.00	0.00	0.00
HSI	0.80	0.48	1.00	0.45	0.80	0.00	0.00	0.00	0.00

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	57	60	68	77	84	27	35	42	50
RAI Cover Type	S	S	S	S	S	SGCM	SGCM	SGCM	SGCM
			XX						
Meadowlark									
V1	0.10	0.10	0.70	0.10	0.10	0.00	0.05	0.00	0.30
V2	0.20	0.20	0.30	0.30	0.20	0.00	0.00	0.00	0.30
V3	0.00	0.00	0.30	0.30	0.30	0.00	1.00	0.00	1.00
V4	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.25
V5	0.00	0.00	0.00	0.20	0.00	1.00	1.00	1.00	0.70
HSI									
Chickadee									
V1									
V2									
V3									
HSI									
Yellow Warbler									
V1	0.70	1.00	0.70	0.50	0.70				
V2	0.50	1.00	0.25	1.00	1.00				
V3	0.25	0.40	0.60	0.25	0.10				
HSI	0.44	0.74	0.47	0.50	0.41				
Great Blue Heron									
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	0.10	0.10	0.10	1.00	0.30	1.00	0.10	0.10	0.30
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI						1.00	0.10	0.10	0.30
Downy Woodpecke									
V1									
V2									
HSI									

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	78	21	31	33	38	74	86
RAI Cover Type	SGCM	SSG	SSG	SSG	SSG	SSG	SSG
California Quail							
V1	0.00	0.60	0.30	0.30	0.60	1.00	0.30
V2	0.00	0.40	0.40	0.40	0.40	0.40	0.50
V3	1.00	1.00	0.50	0.30	1.00	1.00	0.10
V4	0.00	1.00	1.00	0.50	0.30	0.30	0.30
V5	0.30	0.75	0.60	0.10	0.40	0.75	0.40
HSI		1.00	1.00	0.95	1.00	1.00	1.00
Plots > 1.0		XX	XX		XX	XX	XX
Canada Goose							
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V4	1.00	1.00	0.00	0.50	0.00	0.10	1.00
HSI	1.00	1.00	0.71	0.87	0.71	0.74	1.00
Mallard							
V3	0.00	0.20	0.10	0.20	0.20	0.10	0.20
V4	0.00	0.20	0.10	0.20	0.20	0.10	0.20
V5	0.00	0.40	0.40	1.00	1.00	1.00	1.00
V6	1.00	0.50	1.00	1.00	1.00	1.00	1.00
V7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V-8	1.00	1.00	1.00	0.50	1.00	1.00	0.50
V-9	0.30	0.00	0.00	0.00	0.00	0.00	0.00
HSI	0.00	0.14	0.20	0.45	0.45	0.32	0.45
Spotted Sandpiper							
V1	0.00	0.00	0.50	0.00	0.00	0.00	0.50
V2	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V3	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	0.67						
Mink							
V1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V2	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V3	0.10	0.75	0.20	0.50	0.50	0.20	0.50
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	0.10	0.10	0.10	0.10	0.10	0.10	0.10
V6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HSI	0.00						

Table C-9. Replace Column Number from Field Sheet With HSI Score.

Serial Number	78	21	31	33	38	74	86
RAI Cover Type	SGCM	SSG	SSG	SSG	SSG	SSG	SSG
Meadowlark							
V1	0.00	0.30	0.10	0.10	0.30	0.70	0.10
V2	0.00	0.30	0.20	0.20	0.30	0.70	0.20
V3	0.00	0.30	1.00	1.00	0.30	1.00	1.00
V4	0.00	1.00	1.00	0.75	0.75	0.75	0.75
V5	1.00	0.00	0.70	0.20	0.20	0.70	0.20
HSI		0.00	0.10	0.02	0.03	0.42	0.02
Chickadee							
V1							
V2							
V3							
HSI							
Yellow Warbler							
V1							
V2							
V3							
HSI							
Great Blue Heron							
V1	1.00	1.00	1.00	1.00	1.00	1.00	1.00
V2	1.00	0.30	0.10	0.30	0.30	0.30	0.30
V3	1.00	0.30	1.00	1.00	1.00	1.00	0.50
V4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V5	1.00	1.00	0.00	1.00	1.00	0.50	1.00
V6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HSI	1.00	0.09	0.10	0.30	0.30	0.30	0.15
Downy Woodpecke							
V1							
V2							
HSI							

Table C-10. Yakama Method with HSI Scores replacing step values for samle plots.

Serial Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RAI Cover Type	G	PEM	G	Ag-pf	Ag-pf	POW	Ag-pf	PEM	PEM	F	R	PEM	PEM	G	Ag-pf
1. California Quail	1.0		0.7	1.0	1.0		1.0							1.0	1.0
2. Canada Goose	0.9		0.9	0.7	0.7	0.7	1.0			0.7				0.9	0.7
3. Mallard	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.5	0.0			0.9	0.5	0.3	0.2
4. Spotted Sandpiper															
5. Mink		0.2						0.2	0.7	0.4	0.2	0.9	0.6		
6. Meadowlark	0.0		0.0	0.4	0.4		0.5							0.5	0.3
7. Black-capped Chickadee										0.6					
8. Yellow Warbler	0.0														
9. Great Blue Heron	0.0		0.0	0.0	0.1	0.7	0.2			0.7	0.7			0.3	0.1
10. Downy Woodpecker										0.8					

Serial Number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
RAI Cover Type	R	Ag-pf	PEM	S	Ag-pf	SSG	F	F	F	F	H	SGCM	Ag-p	PAB4	S
1. California Quail		0.9		1.0	1.0	1.0					1.0		1.0		1.0
2. Canada Goose		0.7			0.7	1.0	1.0	0.7	0.7	0.7	0.7	0.7	0.7		
3. Mallard		0.5	0.9		1.0	0.1					0.0	0.0	0.4	0.9	
4. Spotted Sandpiper												0.7			
5. Mink	0.2		0.7	0.9			0.7	0.9	1.0	1.0		0.0		0.9	0.8
6. Meadowlark		0.2	0.0		0.3	0.0							0.5		
7. Black-capped Chickadee							1.0	0.0	1.0	1.0					
8. Yellow Warbler				0.8											0.5
9. Great Blue Heron	0.7	0.3			0.3	0.1	0.0	0.5	0.0	0.0		1.0	0.5		
10. Downy Woodpecker							0.8	0.0	0.8	0.8					

Table C-10. Yakama Method with HSI Scores replacing step values for samle plots.

Serial Number	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
RAI Cover Type	SSG	Ag-pf	SSG	F	SGCM	R	PEM	SSG	G	PAB4	Ag-p	SGCM	R	Ag-p	Ag-p
1. California Quail	1.0	1.0	1.0					1.0	1.0		1.0			1.0	1.0
2. Canada Goose	0.7	0.7	0.9	0.5	0.7			0.7	0.7		0.7	0.7		0.7	0.7
3. Mallard	0.2	0.4	0.4		0.0		0.9	0.4	0.2	0.5	0.3	0.0		0.1	0.1
4. Spotted Sandpiper					0.7							0.7			
5. Mink				0.8	0.0	0.3	0.7			0.2		0.0	0.6		
6. Meadowlark	0.1	0.5	0.0					0.0	0.3		0.9			0.2	0.2
7. Black-capped Chickadee				0.9											
8. Yellow Warbler															
9. Great Blue Heron	0.1	0.3	0.3	0.3	0.1	1.0		0.3	0.2		0.3	0.1	1.0	0.3	0.3
10. Downy Woodpecker				1.0											

Serial Number	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
RAI Cover Type	Ag-pf	R	S	Ag-p	SGCM	PEM	Ag-pf	L	Ag-pf	Ag-c	H	S	Ag-pf	POW	S
1. California Quail	1.0		1.0	1.0			1.0		1.0		1.0	1.0	1.0		1.0
2. Canada Goose	0.7			0.7	0.7		0.7	0.7	0.7		0.7		0.7	0.7	
3. Mallard	0.4			0.0	0.2	0.9	0.5	0.3	0.4		0.0		0.4	0.3	
4. Spotted Sandpiper					0.7										
5. Mink		0.3	0.6		0.0	0.9						0.8			0.5
6. Meadowlark	0.3			0.5			0.1		0.3				0.3		
7. Black-capped Chickadee															
8. Yellow Warbler			0.7									0.4			0.7
9. Great Blue Heron	0.3	0.7		0.3	0.3		0.2	0.2	0.3				0.3	0.1	
10. Downy Woodpecker															

Table C-10. Yakama Method with HSI Scores replacing step values for samle plots.

Serial Number	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
RAI Cover Type	POW	H	PAB4	PAB4	G	L	G	S	Ag-cf	G	F	PEM	F	SSG	R
1. California Quail		1.0			1.0		1.0	1.0	1.0	1.0				1.0	
2. Canada Goose	0.7	0.7			0.7	0.7	0.7			0.7	0.7		0.7	0.7	
3. Mallard	0.3	0.0	0.9	0.9	0.5	0.3	0.4			0.9		0.9		0.3	
4. Spotted Sandpiper															
5. Mink			0.2	0.2				1.0			1.0	0.7	1.0		0.6
6. Meadowlark					0.3		0.6			0.0				0.4	
7. Black-capped Chickadee											0.8		0.8		
8. Yellow Warbler								0.5							
9. Great Blue Heron	0.1				0.5	0.4	0.3			0.3	0.0		0.1	0.3	1.0
10. Downy Woodpecker											0.8		0.2		

Serial Number	76	77	78	79	80	81	82	83	84	85	86	87	88
RAI Cover Type	R	S	SGCM	G	Ag-cf	Ag-pf	Ag-pf	F	S	PEM	SSG	R	H
1. California Quail		1.0		1.0	1.0	1.0	1.0		1.0		1.0		1.0
2. Canada Goose			1.0	1.0		1.0	1.0	1.0			1.0		0.9
3. Mallard			0.0	0.9	0.0	0.7	0.7			0.9	0.4		0.4
4. Spotted Sandpiper			0.7										
5. Mink	0.3	0.5	0.0					0.8	0.8	0.8		0.3	
6. Meadowlark				0.3		0.4	0.5				0.0		
7. Black-capped Chickadee								0.9					
8. Yellow Warbler		0.5							0.4				
9. Great Blue Heron	1.0		1.0	0.3		0.2	0.3	0.0			0.2	0.3	
10. Downy Woodpecker								1.0					